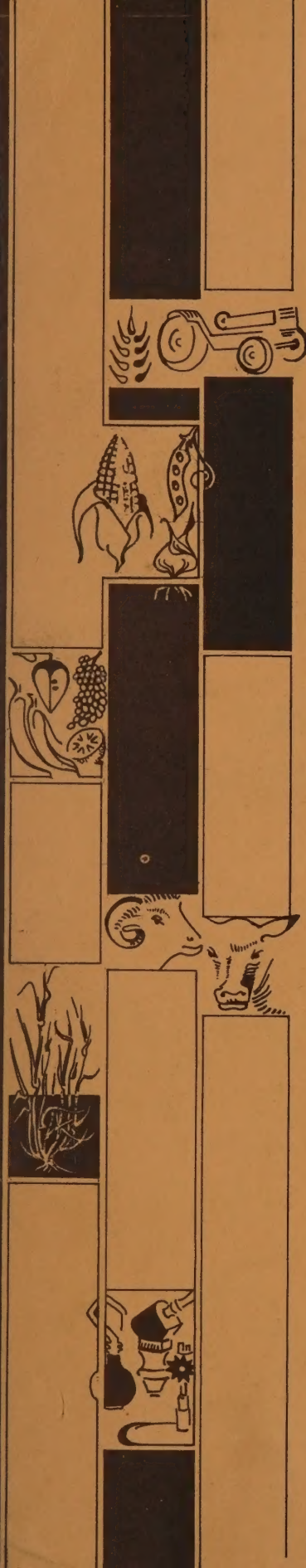

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LANDBOUNAVORSING
AGRICULTURAL RESEARCH
1982

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Departement van Landbou en Visserye
Department of Agriculture and Fisheries

LANDBOUNAVORSING
AGRICULTURAL RESEARCH
1982

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LANDBOUNAVORSING
AGRICULTURAL RESEARCH
1982

AGRICULTURAL RESEARCH
1981.04.01 - 1982.03.31

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PLANT PRODUCTION PROMOTION

AGRONOMY RESEARCH

Summer Grain

MAIZE

METEOROLOGY

R. Eicker: THE STUDY OF THE INFLUENCE OF TEMPERATURE AND RADIATION ON THE TIME OF FLOWERING OF MAIZE AT POTCHEFSTROOM.
[Research Project (A)S-Pr.57/2]
M.Sc.(Agric.): University of the Orange Free State. 1981
Supervisor: Prof. J.M. de Jager

Knowledge of the time of flowering of maize is, for various reasons, of the utmost importance to the breeder, farmer and canner. The aim of this study has been to find a simple but useful climatic index to forecast flowering date under various climatic conditions.

A comprehensive literature survey revealed that a specific technique or index could forecast flowering date reasonably accurately under specific climatic conditions while it would not do well under different climatic conditions. This indicated that these indices were dependent upon climate and are thus deemed unreliable. To find a reliable index, a random experiment was carried out at Potchefstroom over three seasons which included 14 indices, six maize cultivars, four planting dates and three repetitions per planting date per cultivar. During the fourth season meteorological data were used to calculate the flowering dates of the different cultivars.

To determine the degree of climate independence of each index the following test criteria were used:

(a) In the graphical representation of planting date (X axis) against critical index value (Y axis) it was expected of the regression line to be horizontal.
(b) No correlation should exist between planting date and critical index value.
(c) A high normalised slope coefficient indicates an unwanted relationship between the specific index and planting date and indicates unreliability.
(d) A high coefficient of variation or a high degree of variability around the mean of the critical index value was also taken as a measure of unreliability.
(e) A high Z value, which indicates the reliability of the index, indicates the ability of an index to show up cultivar differences while being independent of environmental differences due to a high F value for cultivars and low F value for environment.
(f) After having passed the above criteria, an index must accurately predict flowering date during the next season.

The index which comes out best was heat units with a base temperature of 10 °C and cut-off temperature of 25 °C. This index was largely independent of climatic conditions and forecast flowering dates of six maize cultivars within four days. Its Z values, however, tended to be on the low side. The criteria used isolated an index which lessened climatic differences and can therefore not be used as an index for predicting yield. For yield prediction other, more climatic-dependent indices are better.

Small Grain

BARLEY

BIOTESTING

J.W. Loubser: THE EFFECT OF THE APPLICATION OF 2,4-D ON THE DEVELOPMENT, GROWTH AND SENSITIVITY OF THE BARLEY CULTIVAR CLIPPER.
(Research Project W-Sb.77/7)
M.Sc.(Agric.): University of Stellenbosch. 1980
Supervisor: Mr A.L.P. Cairns

An investigation was undertaken to identify the stages of sensitivity and tolerance of barley to damage by the herbicide 2,4-D, as influenced by the apical development stage at time of application. For this purpose a growth stage classification scheme was drawn up, which describes and illustrates the different stages of development of the barley apex. The barley plant was very susceptible during the vegetative growth phase, but showed a high degree of tolerance from the stage where the upper ridge of each central pair of double ridges became enlarged, until the awns began to develop. This was followed by a second susceptible period which lasted until the awns emerged at the flag leaf ligula. Growth stage 18, when the length of the awn exceeds the terminal spike by about 20 mm, was identified as the most sensitive stage during the second susceptible period.

The relationship between five morphological characteristics and stages of apical development was examined. The correlation between leaf number, leaf sheath length, apex length and number of spikelet primordia of the main tiller, and growth stage were all well above 0,9. The correlation between growth stage and tiller number was slightly less under natural environmental conditions ($r = 0,896$). A linear relationship with a correlation coefficient of $r = 0,983$ was found between apical development stage and the position of the damaged spikelet on the ear. Treatments at growth stage 3 resulted in abnormalities of the basal spikelets. At growth stage 6 the abnormalities were in the middle of the ear, while treatment at growth stage 9 caused damage of spikelets near the ear terminal.

Treatment with 2,4-D delayed apical development and decreased the length of the growth point, but had no effect on the number of leaves on the main tiller or on tiller number. The treatments had a relatively small effect on the growth of barley, as determined by various growth indices. Applications of 2,4-D at an early growth stage had a more harmful effect on plant growth and on photosynthesis. Their recovery also was much slower than plants treated at a later growth stage.

The grain yield of the main culm and following four tillers of plants grown under a controlled environment, was significantly reduced by herbicide applications during the vegetative and early flag leaf stages. The reduction in yield was caused mainly by a lower number of kernels. The mass per kernel was not significantly affected.

Herbicide application at different growth stages had no significant effect on plumpness, germination, protein and alpha amilase content of the barley seed.

WHEAT

NUTRITION

W-Lg.4: MANURE AND STRAW TRIAL WITH WHEAT. 1937-1981
V.D. Wassermann

Although started in 1933 at Langgewens Experimental Station, after considering the early results, it was decided at the end of 1937 to change some of the ten treatments. The data stretch over a period from 1938 to 1976 when the trial was suspended.

The treatments applied were the following:

Treatment	Fertilisation applied
1. Control	No organic fertilisation. 16,7 kg N (33,4 kg from 1962) and 2,34 kg P (16,7 kg from 1948)
2. 1,5 t straw	Balanced fertilisation. Meaning that the available N + P in the organic substances is subtracted from the full fertilisation, and the balance applied through inorganic fertilisers
3. 1,5 t straw	Full fertilisation
4. 3,0 t straw	Balanced fertilisation as under 2
5. 3,0 t straw	Full fertilisation
6. 3,0 t straw	Balanced fertilisation but N and $^1/_3$ P applied during fallow cultivation
7. 6,0 t straw	Balanced fertilisation
8. 6,0 t straw	Full fertilisation
9. 14,0 t strawy manure	Balanced fertilisation
10. 0 t rotted manure	Balanced fertilisation

The straw and the strawy manure were ploughed in at fallowing as against the rotted manure and inorganic fertiliser which were applied at the last soil cultivation prior to sowing.

Because the composition of the strawy manure varied from year to year the N application in treatment 9 was increased to the level of full fertilisation as indicated by the nitrogen composition of the strawy manure ploughed in during the previous year.

This trial originally based on a wheat-fallow system was later changed to a wheat, stubble, fallow system. A further development in the trial was the inclusion of an annual legume crop *(Medicago truncatula)* after the experimental plots were limed in 1968.

Because the trial stretched over so many years, it was not practical to sow one wheat cultivar throughout the duration of the trial. It was decided to use the most adaptable cultivar which meant that new, disease-resistant cultivars were chosen throughout the trial period.

The experimental technique was kept as simple as possible by using the usual farm implements found on any wheat farm in the area.

The mean yield figures over the 39 years reported were disappointing especially those with the high manure applications. These plots at a glance looked much better than the control.

In treatment 10 the soil was noticeably darker in colour and with ploughing the soil worked better with less hard large clod formation. Significant differences were found with carbon content determinations as well as soil modulus of structure analyses. There was a clear decline in breaking strength with higher application of organic fertilisation. In agreement with the general appearance of the soil, treatment 10 boasted the lowest soil modulus of structure.

Although the application of organic material significantly benefited the physical soil properties, it would seem according to the trial results that the over-riding effect on yield was due to the available soil nitrogen.

From the results of this trial it would seem to be totally unpractical and much too costly to increase soil fertility by the addition of organic material in the quantities described.

WHEAT

NUTRITION

S.A. Barnard:

THE EFFECT OF NITROGEN AT SUCCESSIVE GROWTH STAGES ON GRAIN QUALITY OF THE WHEAT CULTIVAR LIESBEECK.
(Research Project W-Sb.150/1)
M.Sc.: University of Stellenbosch. 1981
Supervisor: Prof. E.W. Laubscher

The effect of supplementary nitrogen application on the wheat cultivar Liesbeeck was evaluated in terms of morphological components, as well as protein and gluten component contents, in a glasshouse at a day/night temperature of 18 °C/12 °C.

Two different methods of application were used, firstly to the soil at planting and secondly with successive foliar applications at different growth stages (Table 1).

TABLE 1 - Nitrogen treatments of wheat cultivar Liesbeeck at different growth stages

Treatments	Nitrogen soil application	Nitrogen foliar application			
	At planting	30 days after emergence	Average growth stages		
			15	21	24,5
1	*Ng				
2	Ng	*Ng 30 (gs 6,1)			
3	Ng		*sp		
4	Ng			sp	
5	Ng				sp
6	Ng		sp	sp	sp

*Ng = 45 kg N/ha at planting
*Ng 30 = 45 kg N/ha at planting + 45 kg N/ha 30 days after emergence, both applied to the soil
*sp = Urea foliar application at 45 kg N/ha at each spraying

Results

Nitrogen applied to the soil at growth stage 6,1 at a rate of 45 kg N/ha increased leaf area at growth stage 12,9. Successive nitrogen applications at growth stages 14,8, 20,5 and 23,8 (treatment 6) increased leaf area significantly.

A high leaf area increment at growth phase 5 to 10 followed nitrogen applications at growth stages 6,1 and 14,8 for treatments 2 and 6.

Both area and leaf mass increased when supplementary nitrogen was applied at growth stages 6,1 and 14,8 for treatments 2 and 6, respectively.

An early nitrogen application as for treatment 2 resulted in a higher leaf mass at growth stages 15 to 17 and successive nitrogen applications in treatment 6 had a beneficial effect on plant mass up to anthesis (growth stage 23) before grain filling set in. Leaf mass of the plants of treatment 2 was more than 50 % of the total plant mass at growth stage 15,1. Successive nitrogen application at growth stages 14,8 to 23,4 for treatment 6 showed a similar beneficial effect on leaf mass at growth stage 23,4.

No differences in effect of nitrogen application on relative growth rate (RGR) of net assimilation rate were obtained up to growth stage 23,4.

Treatments 2 and 6 produced the highest ear mass, kernel mass and plant kernel number. Treatments 2 and 6 also produced the highest number of spikelets per plant but were not significantly better than for any other treatment (Table 2). Mass per kernel did not reveal the same order as was the case for ear mass, kernel mass and kernel number.

TABLE 2 - Ear mass, kernel number, spikelet number, kernel mass and mass per kernel of wheat cultivar Liesbeeck receiving different nitrogen applications at successive growth stages

Treat-ments	Ear mass	Kernel number	Spikelet number	Kernel mass	Mass/kernel
	g			g	g
1	5,7	154,4	81,3	4,3	0,028
2	8,6	205,4	93,5	6,5	0,032
3	8,4	195,9	91,0	6,3	0,032
4	7,1	166,3	77,8	5,7	0,035
5	6,5	159,3	79,5	5,1	0,032
6	8,9	207,4	94,0	7,0	0,034
LSD = (0,05)	1,9	41,57	16,3	1,5	0,034

In comparison with the control treatment where nitrogen was administered at planting, nitrogen application at anthesis increased the protein content of kernels from 12,8 % to 17,8 %, reflecting an increase of 39 %.

It was found that the wet gluten content was increased by 93 % with the highest foliar nitrogen application (Table 3).

Increased protein content up to 17,8 % with higher nitrogen foliar applications resulted in an increase in peak height and a decrease in peak time of the mixogram (Table 3).

TABLE 3 - Treatments, protein content, mixograph readings and gluten content of wheat cultivar Liesbeeck receiving different nitrogen application

Treatments	Nitrogen treatments	Protein content	Mixograph readings		Gluten content %	
		%	Peak time min	Peak height mm	Wet	Dry
1	At planting (soil applied)	12,8	2,75	57,75	24,3	8,9
2	At planting and 30 days at growth stage (gs) 6,1 (soil applied)	13,5	2,75	61,50	30,9	11,3
3	At planting and at gs 15 (foliar spray)	13,9	2,50	62,75	31,9	11,7
4	At planting and at gs 21 (foliar spray)	14,5	2,53	66,25	34,6	11,8
5	At planting and at gs 24,5 (foliar spray)	14,7	2,50	63,75	35,2	12,3
6	At planting and at gs 14,8; 20,5 and 23,8 (foliar spray)	17,8	2,10	75,00	46,9	15,6
	LSD = (0,05)	1,3	0,41	2,12	2,28	0,33

Rate of dough development and dough weakening increased with increasing protein content. The angle of tolerance subsequently decreased.

Separation of the flour components by using gel chromatography showed that both glutenin and gliadin fractions increased with increase in protein content of the kernels up to a level of between 14,5 % to 15 %. With further increase in protein level the glutenin content was slightly lowered with a corresponding increase in the gliadin component.

The globulin content remained more or less constant while albumins showed a gradual decrease with increased protein.

Fractionation of different gluten components by iso-electrofocusing techniques showed no differences in band patterns of glutenins or gliadins for the different treatments.

HORTICULTURAL RESEARCH

Tuber Crops

POTATOES

CHEMICAL CONTROL

W-Sb.135/3: POTATO PRODUCTION IN THE WINTER RAINFALL AREA: WEED CONTROL IN POTATOES. 1977-1981

J. Stander

The trial was laid out at George on a soil containing 6,57 % clay, 16,2 % loam and 77,2 % sand. A wide range of weed species occurred in both the autumn and the spring plantings, causing a yield loss of 21,4 % in the former and 28,5 % in the latter compared to the yields obtained from plots where the weeds were controlled mechanically by cultivating the land. According to the yields chemical weed control was just as good as mechanical control. The following chemicals were used as a pre-emergence spray:

(a) Metribuzin (0,75 kg/ha)
(b) Linuron (2,00 kg/ha)
(c) Paraquat (2,5 ℓ/ha)
(d) Terbutryne + Terbuthylazine (4 kg/ha) + Metolachlor (2,75 ℓ/ha)
(e) Metolachlor (2,75 ℓ/ha)

The last two treatments were only applied in the autumn planting in 1979 where they replaced the treatment with Linuron and Paraquat, respectively.

TABLE 1 - Potato yields as affected by the method of weed control

Treatments	Yield (t/ha)						
	Spring planting			Autumn planting			
	1977	1978	Mean	1977	1978	1979	Mean
Metribuzin	41,3	34,6	37,9	13,60	32,60	16,8	21,0
Linuron	42,4	32,3	37,4	10,10	30,80	-	20,5
Paraquat	40,2	30,4	35,3	12,06	28,20	-	20,1
Terbutryne + Terbuthylazine + Metolachlor	-	-	-	-	-	16,8	-
Metolachlor	-	-	-	-	-	16,8	-
Mechanical weed control	41,6	33,9	37,8	10,9	36,7	17,4	21,7

As shown in Table 1 there were no significant yield differences between plots where Metribuzin or Linuron was used and those where weeds were controlled by inter-row cultivations. Although tested for only one planting, the yield of plots treated with Terbutryne + Terbuthylazine + Metolachlor and Metolachlor alone also compared very well with yields obtained from mechanically controlled plots. The yields obtained from plots sprayed with Paraquat were almost always slightly lower than yields from other treatments, because Paraquat has no residual effect and weed emerging after spraying are unaffected and can still compete with the potato crop.

POTATOES

CROP SCIENCE

TB.2411/30/2/5: (T-Rp.24/7)

THE EFFECT OF SEED SIZE AND PLANTING PATTERN ON POTATO PRODUCTION AT SANDVET. 1980-1981

G.S. Cloete

The effect of four seed sizes (10-60, 61-100, 101-140 and 141-180 g) and four in-row spacings (10, 20, 30 and 40 cm) on the production of the potato cultivar BP1 was tested in a randomised block design experiment which was conducted on a sandy soil under irrigation at Sandvet.

The yield was divided into classes according to tuber sizes: $<$ 30, 30-100, 101-150, 151-200 and $>$200 g. Treatments were compared by means of Tukey's test at $P = 0,05$.

A large seed tuber ($>$100 g) yielded a greater total mass and number of tubers, but this could be ascribed to a higher yield of small tubers. Seed size did not affect the yield of table potatoes (tubers$>$100 g). To save on the cost of seed there is no advantage in planting seeds larger than 100 g if they are well sprouted and certified.

Except for the largest tubers ($>$200 g) it was found that narrow spacings (10 to 20 cm) resulted in higher total yields (mass and number of tubers) than the wider spacings in the row (30 to 40 cm). According to the results of the experiment, the table potato producer should space well sprouted seed 20 cm apart in the row to obtain the highest yield.

POTATOES

CROP SCIENCE

T-Rp.24/11:

THE EFFECT OF PLANTING DATE AND STAGE OF FOLIAGE REMOVAL ON SEED POTATO PRODUCTION AT RIETRIVIER. 1980-1981

G.S. Cloete

The object of this experiment was the determination of the effect of different planting dates and stages of foliage removal on seed potato production under irrigation.

The experiment was designed as a randomised block with three replications, and was conducted on a sandy clay loam, alluvial soil with 75% sand. Flood irrigation was applied between planting hills according to evaporation from a Class A pan.

Four planting dates (4th January, 18th January, 2nd February and 15th February, 1980) were tested

in combination with four stages of foliage removal (80, 87, 94 days after planting and no foliage removed).

When the effect of planting date on the total yield is compared at a constant stage of foliage removal, the following conclusions may be drawn: when foliage was removed at 80 and 87 days after planting, a significantly higher yield was obtained with a planting date at the beginning of February compared to the beginning of January. The high temperatures after planting during January could have had an adverse effect on tuber initiation and development in comparison with a planting date during the first half of February. When the foliage was removed 80 to 87 days after planting, the tubers did not have sufficient time to develop.

If the effect of stage of foliage removal on total yield is compared at a constant planting date, the following is concluded: with a planting date at the beginning of January, zero foliage removal resulted in a significantly higher total mass of potatoes than foliage removal at 80 or 87 days after planting.

It was once again obvious that tuber initiation and tuber growth cannot take place until the temperatures have dropped sufficiently for tuber development during February and March at Rietrivier.

It is consequently recommended that seed potato growers should not plant potatoes until the end of January to the beginning of February. In combination with this planting date, the seed potato grower should not remove the foliage before 94 days after planting (beginning of May) to obtain the highest seed potato yield.

POTATOES

CROP SCIENCE

T-Rp.24/14: THE EVALUATION OF THE INFLUENCE OF HAULM DESICCANTS ON POTATO YIELD. 1980-1982
M.A. de Villiers and K.P. Prinsloo

Diquat, paraquat and dinoseb were used in a trial to evaluate their influence as haulm desiccants on the yield and quality of potatoes.

No significant differences in yield or tuber condition could be discovered among the desiccants used. As yield and tuber quality were the criteria used to assess the haulm desiccants the project is being terminated.

Flowers and Ornamentals

POT PLANTS

CROP SCIENCE

TB.2433/30/2/1: THE DEVELOPMENT AND IMPROVEMENT OF CERTAIN INDIGENOUS SPECIES OF FLOWERING PLANTS FOR USE AS POT PLANTS. 1979-1981
H.L. Pearse

Several indigenous species of *Plectranthus* have shown considerable promise for production as commercial flowering pot plants. All those tested were vigorous, quick-growing perennials and were easily propagated from cuttings. They could be rooted directly in the potting compost in the pots for flowering. They were relatively free from pests and diseases and stood up well to indoor conditions when removed from the glasshouse.

Promising species were as follows:

Plectranthus ortendahlii

This species is attractive both as a foliage plant and as a decorative flowering plant. The foliage is an attractive olive green with light silvery veins and the flowers are pale cream with a light pink tinge. Plants can be forced into flower at any time of the year by applying a day-length of 10 h and are therefore suitable for year round production. Plant size can be controlled by treatment with a growth retardant.

POT PLANTS

Plectranthus behrii

This species has oval shaped leaves with serrated edges and these are heavily tinged with purple, especially on the veins. The flowers are light pink and are borne in spikes, carrying numerous individual flowers. It responds readily to growth retardants and can be forced into flower by short day-length treatment. Production time from the cutting is about 12 weeks and the flowering plants remain in good condition for about 3 weeks.

Plectranthus barbatus

This species with large variegated leaves in green and cream pastel colours makes an attractive and unusual foliage plant. It can be propagated from tip cuttings set directly in the compost in the pots and standing uncovered on the glasshouse bench. The plants can be shaped to the required size by treatment with a growth retardant. All year round production is easily attained and the plants last well under household conditions.

Ruttya fruticosa

This species belongs to the family Acanthaceae and is popularly known as Jammy Mouth on account of the unusual orange coloured flowers with much darker brown throat. It is easily propagated from cuttings and when rooted during the months from October to March will flower at the required shape and size for a balanced pot plant, without requiring special dwarfing treatment. This species makes an attractive novelty pot plant that lasts well under household conditions. Attempts to induce flowering out of season have so far not been successful.

Many other indigenous species have been tested but have not proved useful as flowering pot plants due to various factors. These were poor keeping quality, unpleasant odour or the presence of poisonous and irritating substances. Some failed to react to growth retardants and others could not be induced to flower as miniature plants.

The two species reported as successful flowering pot plants in the previous report, namely *Pentas lanceolatus* and *Hypoestes aristata* have continued to receive attention both locally and overseas. Pamphlets giving production techniques for these two species have been published and are available. These are No. S.7 *Hypoestes aristata* and No. S.10 *Pentas*.

Pome and Stone Fruit

APPLES

CROP SCIENCE

(S)WP.247/3: INFLUENCE OF PRE-HARVEST AND PRE-COOLING FACTORS ON KEEPING QUALITY: IDENTIFICATION OF FACTORS INDUCING BRUISING WITH GOLDEN DELICIOUS APPLES. 1979-1981
1979-1981
G.J. Eksteen

This facet extended over three seasons and consisted of both field and laboratory experiments. The first series of field tests proved that:

1. Bruising increases as the apples mature in spite of a decrease in available soil moisture over the same period;
2. apples picked during the early morning are more susceptible to bruising than apples picked later during the day;
3. apples cold stored for less than 5 days are more susceptible to bruising than apples stored longer than this period;
4. bruise susceptibility is not related to physical characteristics such as turgor pressure, fruit firmness and cell elasticity;
5. most bruising occur on the sorting and grading machines but can be reduced considerably by effective padding of contact points.

During the second series of tests it was proved that:

1. Wilting of the fruit at ambient conditions prior to cold storage did not affect bruise susceptibility but may induce bitter pit and yellowing;
2. the least bruising was found in apples cold stored for more than 7 days.

From the above it was concluded that Golden Delicious apples must be pre-cooled immediately after harvesting to -0,5 °C and then stored at this temperature for at least 7 days to allow moisture loss at a low temperature. This procedure was checked in two commercial cold stores and proved to be valid under commercial conditions.

The series of laboratory tests proved that the 6 % tolerance of unacceptable bruising is reached when Golden Delicious apples are subjected to a vertical drop exceeding 33 mm or when the vertical speed of the apple before contact with a solid object exceeds 0,56 m $sec.^{-1}$. In practice this means that drop height and belt speed should not exceed these values. These results were also checked in a commercial packing house and it was concluded that bruising can be reduced 10-fold by reducing sorting and grading speed.

Minor bruises became visible when the underlying cortex tissue turned brown. If the fruit temperature is kept close to 0 °C browning is reduced considerably. It was also established that browning can be reduced by lowering the temperature of fruit that had warmed up during the packing and handling process.

The results of all these experiments were also checked under commercial conditions and found to be valid in practice. The recommendations made to the industry are generally applied with good success. Research on this topic is therefore terminated.

Publications

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APPLES

PATHOLOGY

(S)WP.236/2: REARING OF LEAFROLLER ON APPLES. 1977-1981

T.L. Blomefield

The object was to develop a practical method for rearing the apple leafroller for pheromonal and biological studies. Diets developed by Barnes (1973), Bot (1965), Briton, Proverbs & Crosby (1969), Sharey & Hale (1965) and Roelof (1967) were each tested for their suitability as a medium for mass-rearing the apple leafroller.

An artificial diet containing nutritional ingredients found in the diets developed by Barnes (1973) and Brinton *et al.* (1969), was developed for the successful mass-rearing of the apple leafroller. On this medium the larvae developed very successfully and the adult moths were robust and active. Many more fertile egg batches were produced than with the other diets.

The formula for the medium is as follows:

Ingredients	g
Digestive bran	54
Wheat germ	16
Crushed whole wheat	13
Vitamin-free casein	7
Torula yeast	12
Carrot powder	25
Sorbic acid	1
Nipagin	1
Acetone	25 mℓ
Ascorbic acid	0,2
Citric acid	1,4
Salt	1,0
Complan	3,5
Choline chloride	0,1
1 N hydrochloric acid	10 mℓ
Sugar	8
Water	100 mℓ

The digestive bran, wheat germ, crushed whole wheat, torula yeast, carrot powder, vitamin-free casein and sorbic acid are thoroughly mixed. The nipagin is dissolved in acetone and thoroughly mixed with the above ingredients. The medium is spread out on plastic to dry. The citric acid, ascorbic acid, salt, sugar, choline chloride and complan are dissolved in water and added to the medium with the hydrochloric acid. The ingredients are mixed well. The medium is then placed in clean glass jars. Instead of vitamin-free casein, 3,5 g of casalan can be used in the medium without affecting the virility of the moths.

The advantage of this medium is that its preparation is simple and it can be stored in the refrigerator for several months.

One publication will be made.

APPLES

PATHOLOGY

(S)WP.236/3: BIONOMICS OF LEAFROLLERS ON APPLES. 1977-1981
T.L. Blomefield

The object was to determine the feasibility of developing a practical sex pheromone monitoring system for the apple leafroller using the synthetic female sex pheromone of a related but foreign leafroller species. To determine this, preliminary trials were conducted during the 1977/78 season with five synthetic sex pheromones of related species of leafrollers in 16 apple and two pear orchards. The apple leafroller was attracted in high numbers to the sex pheromone of the American omnivorous leafroller.

During the 1978/79 season moth catches from within orchards indicated that although the magnitude of the build-up in the moth population varied from orchard to orchard, there was a protracted period of moth flight in all orchards between end October and mid November. This protracted moth flight in October and November resulted in an overlapping of generations during the latter part of the season. After dropping to a low level in December, moth numbers increased during February and March.

The number of moths caught during the 1979/80 season was considerably less than during the 1978/79 season. Moth numbers decreased sharply after end October and remained low for the remainder of the season.

During the 1980/81 season moth populations were dramatically lower than during the 1979/80 season. Since the 1977/78 season leafroller populations have declined sharply to the point where few moths were caught in apple orchards.

The number of moths caught outside orchards was lower than those caught from within orchards, suggesting that moths from outside orchards will not influence catches within orchards. However, the low moth populations recorded during the 1979/80 and 1980/81 seasons made it impossible to substantiate the 1978/79 season's findings.

During the 1978/79 season very few larvae were recorded on terminal leaf shoots. From November to April during which time 11 500 shoots were inspected, only 70 larvae were recorded. Due to the low number of moths recorded during the 1979/80 and 1980/81 seasons leaf shoots were not inspected.

Research on the development of a sex pheromone monitoring system for the apple leafroller should be discontinued. It is impossible to develop such a system for this pest under conditions of continual low population occurrence.

These findings will be published in due course.

APPLES

PESTS

W.F.S. Schwabe: ETIOLOGY AND EPIDEMIOLOGY OF BACTERIAL, FUNGUS AND VIRUS DISEASES IN ORCHARDS: DEVELOPMENT OF A WARNING SERVICE AGAINST APPLE SCAB.
[Research Project (S)WP.256/1]
Ph.D.: University of Stellenbosch. 1980
Supervisor. Prof. P.S. Knox-Davies

A study on apple scab, the most important apple disease, was undertaken. The following aspects involved in the establishment of a warning service in South Africa were investigated:

1. Wetting and temperature requirements for apple leaf infection by *Venturia inaequalis*.

2. Leaf infection as influenced by dew, following rain wetting periods.
3. Changes in scab susceptibility of apple leaves as influenced by age.
4. Wetting and temperature requirements for infection of mature fruit.
5. Greenhouse evaluation of fungicides for apple scab control.
6. Curative activity of fungicides against apple leaf infection by *V. inaequalis*.
7. Tolerance of *V. inaequalis* to benzimidazole fungicides and dodine.
8. Prevention of storage scab.
9. Weather favouring apple scab infection in South Africa.

It has been shown that many factors affected wetting and temperature requirements for establishing different degrees of scab infection. At heavy inoculum potentials light, moderate and heavy infection of susceptible leaves occurred after infection indices [leaf wetting period (h) x mean temperature (°C)] of 100-149, 150-225 and >225, respectively.

In the case of fruit at picking ripe stage and moderate to heavy infection potentials, light, moderate and heavy infection occurred after infection indices of 440-599, 600-1 000 and >1 000, respectively.

When calculating infection indices for leaf infection, intermittent wetting periods should be added together if the dry intervals are not longer than 16 and 32 h with ascospore and conidial inoculum, respectively. It also was concluded that if a wetting period, caused by rain or overhead irrigation, is followed by more than one wetting period caused by dew, only the first dew wetting period should be added to the rain wetting period.

In the case of fruit at picking ripe stage, intermittent wetting resulted in reduced infection in comparison with continuous wetting periods.

The susceptibility of leaves to scab infection was influenced by leaf age. The greatest number of lesions occurred on leaves of well fertilised trees when inoculated 1-5 days after unfolding. Leaves were almost completely resistant 12-13 days after unfolding, i.e. at about the time when leaf expansion ceased.

Mancozeb and metiram, two protective fungicides used for scab control, were very effective both in the greenhouse and in the field under commercial conditions. Therefore, they are strongly recommended as protectants for field use.

Dodine was curatively very effective against lesion formation and conidium production if applied soon after the beginning of an infection period. Benomyl and thiophanate-methyl were effective in suppressing spore production, while triforine was very effective in preventing lesion formation and spore production.

By means of curative fungicide applications, storage scab development was reduced effectively provided that benomyl, dodine or triforine were applied within 72 h after the beginning of an infection period at 15 °C. A preventative mancozeb application protected picking ripe fruit very effectively against scab infection for periods longer than a month.

V. inaequalis tolerant to benzimidazole fungicides and dodine, was found on certain local farms. Benzimidazole fungicides should not be used for scab control on these farms. Where dodine tolerance has developed, dodine can still be used effectively if low dosages and long intervals between spray applications are avoided.

For the determination of wetting periods on different farms, a leaf wetness recorder, a thermo-hygrograph and a rain gauge were found to be necessary. Wetting periods favourable for scab infection differed from farm to farm and from season to season.

Valuable information on the important initial, peak and final ascospore discharge patterns was obtained.

Finally it was concluded that a local scab warning service was justified and that its establishment is possible. It should function as follows:

1. The determination of the infection potential of each orchard at the end of the growing season.
2. The determination of the ascospore discharge pattern in different apple growing areas. According to the information obtained in 1 and 2 a danger index should be calculated.
3. The determination of infection periods for the different apple growing areas.
4. Judicious use of fungicides - starting with a basic protective spray programme, with curative treatments to support the protective programme if necessary.
5. Regular orchard inspections during the whole growing season and adaption of control measures according to the prevailing circumstances.

A reliable general weather forecast will improve the warning service, as well as sufficient spraying equipment available to apple growers to treat their orchards within two days or even less.

Publications

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APPLES

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PEACHES

CROP SCIENCE

(S)WP.252/1: PRODUCTION SYSTEMS AND CROP CONTROL: PRUNING OF KAKAMAS TYPE PEACH TREES TO OBTAIN SMALLER TREES AND A LONGER PRODUCTIVE LIFE. 1971-1981

O. Bergh

Kakamas canning peaches on seedling roots were spaced at 4,8 m x 3,6 m and trained to the pyramid and vase shape at the Bien Donné Experimental Farm. Two pruning treatments were applied, namely summer pruning and winter pruning. A split plot design was chosen consisting of eight tree plots, two main treatments and two subtreatments, replicated three times. Summer pruning consisted of the removal of water shoots and superfluous growth during early November and a complete and final pruning at the end of March. Winter pruning was done during July and standard methods were followed. Care was taken to remove an equal amount of new growth from each of the summer and winter treatments at pruning time.

Results proved that pyramid shaped trees were extremely difficult to train with this vigorous and whippy cultivar, especially in a windy area like Bien Donné with the prevailing south-easter. Fairly drastic pruning was necessary during the first three years to arrive at the correct shape and trees had to be staked. Pyramid shaped trees could not be trained without additional summer pruning and the winter pruning treatment was supplemented during the first three years with summer pruning. The drastic summer pruning resulted in a significant reduction of the trunk cross sectional area as compared to the vase shaped trees but only a slight reduction in the yield per tree. It was proved that the percentage bud drop was significantly reduced by the summer pruning treatments and explained the slight reduction of the yields to some extent. Bud drop was a serious problem in the experimental orchard and was also found to exist in most orchards in the area where adequate chilling hours were lacking.

Contrary to results in some co-operative trials where significant increases in yields resulted after a summer pruning programme was applied, this could not be proved in the trial. No significant differences were found between summer or winter pruned trees. This could be explained by the fact that the orchard suffered a severe setback due to extremely wet soil conditions during 1976 and vigour was impaired to such an extent that shading of trees which normally results at these dense spacings did not occur. It was proved that summer pruning could have no beneficial effect under such conditions and could be dangerous due to the dwarfing effect and thus reduced leaf area. The trial has, however, proved that a closer spacing of the Kakamas type trees is possible and such trees can be maintained at such a spacing by means of the summer manipulations. Optimum production in the trial orchard exceeded 40 t/ha which

was considerably more than in the conventionally spaced 6 m x 6 m orchards in the area where the production seldom exceeds 20 t/ha.

PEACHES

PESTS

(S)WP.233/1: BIONOMICS AND ECOLOGY OF PESTS: DEVELOPMENT OF A MONITORING SYSTEM FOR FALSE CODLING MOTH IN PEACH ORCHARDS. 1977-1980
T.L. Blomefield

The object was to determine the feasibility of developing a practical sex pheromone monitoring system for false codling moth (FCM) in peach orchards. To determine this, a prerequisite was an investigation of the flight patterns and movement of FCM from one fruit variety to another. This was necessary in view of the various deciduous, tropical and subtropical fruits grown in the Western Cape. It was also necessary to determine the optimum trap density per hectare.

It was found that although the general flight patterns from season to season are similar, the magnitude of the FCM populations varied from year to year. The time of appearance of moths in orchards within seasons and between seasons also varied. This variability is apparently due mainly to temperature and rainfall conditions during the winter months. The variability in moth numbers was also determined by the proximity of towns and the number of oak trees in the vicinity of orchards. Consequently, in isolated orchards, early and late cultivars, moth numbers remained low throughout the growing season.

The optimum trap density for an accurate pheromone monitoring system for FCM was found to be one trap/ha. However, such a trap density will be economically unjustifiable, when the price of traps and the cost involved in their maintenance are compared with the cost of sprays.

It was determined that it will only be economically feasible to use FCM traps as an indicator system at a density of one trap/2 ha. At such a trap density traps afford reliable, though not accurate, indications of FCM activity. With such a system, control measures for FCM should be based on any moth activity indicated by the traps at the known times when peaches are subject to attack by this pest.

These findings will be published in due course in *The Decidious Fruit Grower.*

PEACHES

WATER REQUIREMENTS

(A)T-Rp.161/3/1: IRRIGATION REQUIREMENTS OF PEACHES. 1976-1981
T. Haulik

An irrigation trial has been established at the Horticultural Research Institute near Pretoria. The climatic conditions are typical of the Middleveld, which belongs to the summer rainfall area.

The experiment was established at a 3 x 4 factorial layout. Two hundred and sixteen trees were planted at 6 m x 8 m planting distances. The trial contained two cultivars, one of them an early white freestone type, the Rhodes, and the other a late yellow clingstone, the Kakamas.

The results were highly significant ($P<0,01$) and indicated that the highest yield (27,9 t/ha) came from trees which received 1 000 mm water per year. From this amount of fruit 17,2 t was bigger than 57 mm in diameter.

The 1 000 mm water contained 600 mm rainfall and 400 mm irrigation water. A crop factor was determined by using the formula $Qx = (R-V)\ f$

where Qx = quantity of irrigation water applied
R = rainfall
V = evaporation
f = crop factor

The factor is for					
	Dec.	: 0,4	June	: 0,2	
	Jan.	: 0,5	July	: 0,2	
	Feb.	: 0,5	Aug.	: 0,2	
	March	: 0,4	Sept.	: 0,3	
	April	: 0,4	Oct.	: 0,3	
	May	: 0,2	Nov.	: 0,4	

PEACHES

In the 1979/80 season the crop factor was tested in practice by using two cultivars and two replications. Half of the trees were irrigated according to the soil sample method described in the procedure of the irrigation trial and half according to the crop factor. No significant differences were found between the crop of the two treatments.

APRICOTS

TECHNOLOGY

(S)WP.237/5: TECHNOLOGY OF APRICOTS: COMPOSITION AND DRYING PROPERTIES OF APRICOTS. 1979-1981
P.C. Fourie

In an investigation carried out over three seasons a relationship between the pH values of apricots and the absorption of sulphur dioxide during exposure to the fumes of burning sulphur was established. Low pH values resulted in poor sulphur dioxide absorption and a fast rate of browning during storage of the dried fruit. The Palsteyn cultivar, having pH values of pH 3,2 and lower, was particularly susceptible to browning under the same conditions. Within cultivars, variations in pH values occurred which were reflected in the sulphur dioxide absorption and subsequent browning during storage of fruit of different maturities, could be ascribed to pH differences. The composition of apricots was influenced by the growing area and this was reflected in the susceptibility to darkening. In all the cultivars studied the fruit from the Robertson area was more susceptible to browning than fruit from Citrusdal. Contrary to expectations, no relationship existed between glucose content and sulphur dioxide.

PLUMS

CROP SCIENCE

(S)WP.252/2: PRODUCTION SYSTEMS AND CROP CONTROL: A COMPARISON OF THE PALMETTE AND VASE TRAINING SYSTEMS WITH FOUR PLUM CULTIVARS. 1972-1981
O. Bergh

Santa Rosa (3,6 m x 1,8 m), Gaviota (3,6 m x 1,5 m), Kelsey (3,6 m x 1,8 m) and Songold (4,5 m x 2,7 m) plum cultivars were planted in a trial at the Bien Donné Experimental Farm to study the effect of wind damage on the vase shape as compared to the palmette shape. The two training systems were replicated three times in half rows (vase and palmette) of 14 to 8 trees each.

Results proved that the palmette shape had definite advantages in windy areas and reduced the drop of fruit from 51 % to 23 % in the case of the Santa Rosa cultivar during 1977 when a gale force south-easter caused a serious crop loss in the area. The Gaviota, Kelsey and especially Songold cultivars were less susceptible and the reduction in losses ranged from 13-23 %. A calculation of these losses proved that the cost of the trellis which is a prerequisite for the palmette shaper, would have been covered by only one such a loss during the lifetime of the trees.

Although no significant differences were found between training systems with regard to the yield per hectare if wind damage is excluded, it was proved that the vigorous growing cultivars of which Songold is an example, could be grown successfully at higher densities with the palmette shape than the vase shape. The higher density results in earlier and heavier yields during the first number of years which will also offset the high cost of the trellis.

Several problems developed with the training of the palmette shaped trees. These problems were studied in the trial and the system has since been redesigned. New plantings have already been grown successfully where the new design was followed.

Berries

STRAWBERRIES

NUTRITION

(S)WP.175/2: THE SEASONAL ABSORPTION AND DISTRIBUTION OF ESSENTIAL NUTRIENT ELEMENTS BY THE STRAWBERRY CULTIVAR, PARFAITE, GROWN IN SAND CULTURE. 1972-1981
J.H. Terblanche

The seasonal absorption patterns of the elements N, P, K, Ca, Mg, Na, Zn, Cu, B, Fe and Mn have been studied for the strawberry cultivar Parfaite, grown in sand culture. Plant growth was manipulated by a combination of two factors, each at two levels, namely removal of flowers versus normal fruited plants and the absence or presence of nutrification of the runner plants. The established patterns showed a close positive relationship between plant development, expressed in terms of dry mass, and absorption of each individual element (Table 1, p. 16). The nutritional requirements of the strawberry plants are therefore dependent on the annual growth cycle of the plant.

STRAWBERRIES

TECHNOLOGY

(S)WP.242/6: THE EFFECT OF LIFTING DATE AND DURATION OF COLD STORAGE BEFORE PLANTING ON YIELD OF STRAWBERRY RUNNER PLANTS. 1978-1981
C.W.J. Bester and A.B. Truter

In order to determine the effect of digging date and duration of cold storage before planting on the yield of strawberry runner plants, plants of the cultivars Parfaite, Selekta and Tiobelle were lifted from 1 March every fortnight till 1 May. Plants at every digging date were planted without cold storage and after 15 and 30 days of cold storage at 0 °C. The experimental design was a factorial design consisting of cultivars, digging dates and cold storage as treatments and five replications. The experiment was carried out at the Bien Donné Experimental Farm during the 1979 and 1980 seasons.

The results show that yield of Parfaite was not significantly affected by digging date or cold storage treatments. Yield of Selekta and Tiobelle, as affected by these treatments, followed a very similar pattern. There was a significant decrease in yield of Selekta from the first digging date till the latest one, which clearly indicates that this cultivar favours early lifting and planting. Tiobelle gave a significantly higher yield from plants lifted at 1 and 15 March compared to the April lifting and 1 April digging date gave a significantly higher yield than that of 1 May.

Although yield of these two cultivars was not significantly affected by 15 days cold storage at any digging date it was detrimentally affected by 30 days of cold storage.

Viticulture

TABLE GRAPES

PHYSIOLOGY

D.C. Uys: PHYSIOLOGY OF ROOTING AND CALLUS FORMATION IN THE VINE.
[Research Project (S)WP.220]
D.Sc.(Agric.): University of Stellenbosch. 1981
Supervisor: Prof. C.J. Orffer

Several facets with regard to the accumulation and utilisation of reserve nutrients related to propagation of the grapevine were studied.

TABLE 1 - Regression equations for the relationship between dry mass (x) and total nutrient content (y) for the different elements

Element	Normal plants Runners nutrified	r^2	df	Flowers removed Runners nutrified	r^2	df	Normal plants Runners not nutrified	r^2	df	Flowers removed Runners not nutrified	r^2	df
N	$y = 14,3x + 20,37$	9,99	15	$y = 18,2x + 70,8$	0,98	15	$y = 13,2x + 28,9$	0,99	15	$y = 19,4x + 57,3$	0,98	15
P	$y = 2,45x + 4,8$	0,97	15	$y = 2,5x + 7,6$	0,99	15	$y = 2,5x + 4,9$	0,99	15	$y = 2,4x + 8,8$	0,99	15
K	$y = 10x + 7,7$	0,99	15	$y = 21,3x + 6,8$	0,99	15	$y = 15,4x + 12,4$	0,99	15	$y = 19,1x + 17,9$	0,99	15
Ca	$y = 7,4x - 9,9$	0,97	15	$y = 10,9x - 6,7$	0,99	15	$y = 7,4x - 9,2$	0,98	15	$y = 11,2x - 9,4$	0,99	15
Mg	$y = 4,4x - 6,5$	0,96	15	$y = 6,6x + 0,47$	0,99	15	$y = 4,4x - 6,9$	0,96	15	$y = 6,8x - 0,5$	0,99	15
Na	$y = 1203,8x - 5994,5$	0,93	15	$y = 1519,1x - 6442,7$	0,98	15	$y = 1260,7x - 6501,8$	0,94	15	$y = 1646,4x - 7389,5$	0,98	15
B	$y = 22,9x + 29,5$	0,99	11	$y = 28x + 25$	0,99	11	-			-		
Zn	$y = 24,8x + 38,1$	0,96	15	$y = 37,6x + 61,3$	0,98	15	$y = 27,9x + 11,2$	0,96	15	$y = 43,3x + 21,4$	0,99	15
Cu	$y = 0,66x^2 - 7,1x + 63,3$	0,98	14	$y = 0,57x^2 - 2,98x + 80,5$	0,99	14	$y = 0,68x^2 - 8,06x + 67,2$	0,98	14	$y = 0,66x^2 - 6,5x + 93,9$	0,95	14
Fe	$y = 4,27x^2 - 49,2x + 821,5$	0,97	14	$y = 3,72x^2 - 35,9x + 1061,2$	0,97	14	$y = 4,7x^2 - 76,6x + 943,86$	0,95	14	$y = 4,3x^2 - 51,9x + 1082,3$	0,94	14
Mn	$y = 0,32x^2 + 57,9x + 189,8$	0,90	14	$y = 0,64x^2 + 115x + 66,2$	0,96	14	$y = -0,36x^2 + 59,9x + 183,8$	0,91	14	$y = -1,07x^2 + 143,5x - 65,9$	0,98	14

TABLE GRAPES

Seasonal changes in carbohydrate and nitrogen fractions in the shoots (canes) of the mother vine and the effect of the composition of the canes on the callusing, shoot and root growth performance of cuttings taken from them

The developing shoots on Jacquez and Salt Creek mother vines were sampled at monthly intervals and divided into six regions. The seasonal changes in dry mass, sugar, starch, hemicellulose, total N and soluble N were recorded. On 2 August (Southern hemisphere) samples of cuttings for callusing and rooting were taken from each of the six regions. The callusing performance and shoot and root growth were correlated with the various components.

Sugar + starch + hemicellulose as concentration of fresh mass increased in all shoot regions, reaching peaks on 3 May in Salt Creek and 1 June in Jacquez. This was followed by small losses in Jacquez during June and considerable losses in Salt Creek during May and June. During July general small increases took place.

Of the three carbohydrate fractions studied, hemicellulose was the first to start accumulating, reaching peaks on 2 February (% of fresh mass). This was followed by losses after which a second series of peaks was reached on 3 May in Salt Creek and 1 June in Jacquez. This was followed by considerable losses.

On the basis of sugar and starch concentrations of fresh mass, the season can be divided into two distinct stages. The first stage started after bud break and continued until end May to early June. During this stage sugar remained at a fairly constant level around 1-2 %, the excess sugar being converted to starch and other products. The second stage which covered the period early June to early August was characterised by the conversion of starch to sugar during which sugar increased substantially while starch decreased. Throughout the season starch was generally higher in the primary shoot regions than in the secondary shoots. At the final date on 2 August sugar + starch concentration was considerably higher in Jacquez than in Salt Creek.

Initial high total N concentrations (based on fresh mass) decreased to low values around February and March, subsequently showing a steady increase until 2 August. Soluble N followed the same basic pattern as total N in Jacquez. In Salt Creek soluble N also decreased until 2 February, followed by a sudden increase until 1 March and a loss of the same magnitude until 1 April. From then onwards the increase was slower than that of Jacquez, resulting in Salt Creek reaching only about 50 % of the corresponding values recorded in Jacquez on 2 August.

The Jacquez cuttings from different regions showed no significant difference in callusing or shoot and root growth, nor did these show any statistically significant correlation with any of the variables. The Salt Creek cuttings from different regions showed a statistically significant difference in callus score and the latter was also positively correlated with cutting mass.

Effect of cutting date and cold storage of Jacquez and Salt Creek cuttings on the carbohydrate levels and callusing performance

Cuttings were collected at the beginning of the months May to September and analysed and callused immediately. Other cuttings were collected on the first three dates and cold-stored at 0 °C until 1 August when they were callused or analysed for sugar, starch and hemicellulose. Best callusing at the apex was obtained in cuttings collected on 2 May, and second best in those collected on 1 September.

Callusing performance was affected to a lesser extent by carbohydrate concentration than by other undetermined factors. Cold storage generally depressed callusing performance, and the longer the period of storage the greater was its effect.

Effect of callusing period and degree of callusing on the levels of carbohydrate and nitrogen fractions and other macro-elements in different regions of cuttings and scions, as well as the respiration rate of cuttings after callusing for 21 days

Apart from the initial sampling, cuttings of Jacquez and Salt Creek and scions of Waltham Cross were callused for 7, 14 and 21 days. The callusing cuttings and scions sampled after 14 and 21 days were separated into "good" and "poor" callusing groups. All sampled cuttings were then divided into four regions. The samples were analysed for sugar, starch, hemicellulose, total and soluble N, P, K, Ca and Mg, the analytical results being expressed as concentration of initial dry mass and as total content per cutting. Further groups of cuttings of Jacquez and Salt Creek were callused for 21 days, divided as above, and the respiration rate of each region at 25 °C subsequently determined.

The largest carbohydrate losses from the whole cutting or scion comprised sugar in Jacquez and

sugar and starch in Salt Creek and Waltham Cross. Losses of sugar + starch + hemicellulose from Salt Creek were considerably higher than from Jacquez over the full period. During this period little change occurred in the total N content, but that of soluble N increased substantially. With the exception of Mg in Salt Creek which increased marginally, P, K, Ca and Mg were lost from all three cultivars.

The pattern of changes in sugar, starch and hemicellulose concentration in the four regions of Jacquez and Salt Creek was basically similar which indicates that they were depleted or accumulated to the same extent in all regions. This further indicates that the higher respiration rates obtained in the BR and AR were partly maintained by the utilisation of sugars translocated from other regions. These sugars were immediately utilised for respiration and no accumulation took place.

Total N in Jacquez and Salt Creek showed increases in the BR during callusing, while the concentration of soluble N and other macro-elements hardly differed between regions. The "good" and "poor" callusing groups exhibited few differences in respect of all the above-mentioned components.

Effect of callusing temperature on the degree of callusing and carbohydrate utilisation

Apart from the initial sampling, cuttings of Jacquez and Salt Creek were callused at 15 °C, 20 °C and 25 °C for 28 days after which the callus was scored and the cuttings analysed for sugar, starch and hemicellulose. Results were expressed as concentration of initial dry mass.

Callusing was best at 25 °C, slightly poorer at 20 °C and none occurred at 15 °C. In both cultivars callusing was poorer at the apex than at the base, with Jacquez showing a tendency towards better callusing at the apex and poorer callusing at the base than in the case of Salt Creek. The loss of sugar + starch + hemicellulose was positively related to the callusing temperature, Salt Creek showing a lower percentage loss at the two lower temperatures than Jacquez; at 25 °C, however, the percentage loss was about the same in both cultivars.

Effect of cutting length on callusing and carbohyrate utilisation

Apart from the initial sampling, cuttings of Jacquez and Salt Creek of the following lengths were callused for 28 days at 25 °C: 20-25 cm with buds, 8 cm with one bud in the middle, and internodes of 8, 4, 2 and 1 cm. Samples were analysed for sugar, starch and hemicellulose.

Final sugar concentration differed little between cutting lengths, but final starch concentration was positively related to cutting length. The presence or absence of a bud in the 8 cm cuttings had no statistically significant influence on the utilisation of sugar + starch, or on callusing at the base or apex. Cutting length influenced callusing at the base, the shorter cuttings callusing less; budding had no effect on callusing at the apex.

Seasonal changes of carbohydrate fractions during the nursery stage

Cuttings of Jacquez and Salt Creek grown in a sandy soil were sampled for analysis over the full growing season. The sampling dates were as follows: 19 August (before planting), 2, 16, 30 September, 14, 28 October, 11, 25 November, 22 December, 22 January, 23 February, 22 March, 24 May and 23 July. The samples were analysed for sugar, starch and hemicellulose and results expressed on an absolute basis as well as concentration of dry mass.

In both cultivars shoot growth started before root growth, but the latter developed at a greater rate and on 23 July the dry mass ratio of roots to shoots was 3,2:1 for Jacquez and 1,7:1 for Salt Creek. The cuttings were dependent on their sugar, starch and hemicellulose reserves for a period of 12 weeks after planting. Starch, concentration in the stem (cutting) subsequently increased rapidly while sugar concentration remained at a constant low level. Hemicellulose increased concomitantly with starch in the stem. The roots were the most important part for starch storage, while in the shoots hemicellulose was the dominating of the three carbohydrate components.

Effect of growth period and IBA treatment on the levels of carbohydrate and nitrogen fractions and other macro-elements in different regions of cuttings (plants) as well as the respiration rate of the different regions after growing at 18 °C for 21 days

The treatments consisted of control Jacquez and Salt Creek cuttings and others of which the basal

1 cm had been dipped in 1 000 mg/ℓ IBA for 5 min. Apart from an initial sampling of untreated cuttings, cutting of all treatments were planted in acid-washed sand, to be sampled after 7, 14, 28, 42 and 56 days. Planting was done on 28 October at which stage the weather conditions were warmer, and this allowed the changes to be followed in a shorter period of time. Deionised water was used for irrigation. All sampled plants were divided into four regions and in these the dry mass, sugar, starch, hemicellulose, total and soluble N, P, K, Ca and Mg were determined. Analytical results were expressed as content per region and for the whole plant. Further groups of cuttings treated similarly were grown at 18 °C in sand for 21 days, divided as above, and respiration rate of each region at 18 °C in the dark subsequently determined.

The plants lost dry mass until the final sampling, the losses varying between 7,6 and 10,6 %. IBA treatment had no significant effect on dry mass losses. The largest losses in the whole plant were incurred by sugar and starch, but some hemicellulose was also utilised, showing that at least part of the hemicellulose had served as a reserve carbohydrate. IBA treatment had very little effect on the utilisation of the carbohydrate fractions in the whole plant over the full period. In the whole plant there was a loss of total N, P, K, Ca and Mg. Soluble N in Jacquez showed little change, but in Salt Creek it increased during the first 7 days. IBA treatment hardly affected the loss of total N, P, K, Ca and Mg.

In all plant regions the sugar + starch + hemicellulose content was depleted to about the same extent over the full period, but there were some mutual transformations between the fractions resulting in some changes in the distribution of the fractions in the plant. For instance, sugar content in the basal regions changed little in the untreated cuttings but actually increased over the full period in the IBA-treated cuttings.

From a comparison of respiration rates after 21 days and the loss of sugar + starch + hemicellulose it can be deduced that a translocation of carbohydrates in the form of sugars from the middle to the apical and basal regions of the plants must have occurred. IBA treatment stimulated respiration in the BR of Jacquez and Salt Creek.

Three of the elements, N, P and K showed more mobility in the plant with translocation mainly towards the apical region. Ca and Mg showed less mobility, but also a translocation in the same direction. IBA treatment of Jacquez had little effect on translocation of the mobile elements when compared to the control. In Salt Creek IBA stimulated translocation of these elements to the basal region. The sink/source relationship was therefore changed by the IBA treatment.

IBA treatment had a larger stimulatory effect on the formation of soluble N in the Jacquez than in the Salt Creek. This effect was stronger nearer to the base where the IBA had been applied.

TABLE GRAPES

UP-GRADING

(S)WP.244/4: EVALUATION OF TABLE GRAPE CULTIVARS AND SELECTIONS: SELECTION OF THE TABLE GRAPE CULTIVAR NEW CROSS. 1969-1981
E.W. Mostert

An experiment in which 17 New Cross clones, two of which included standard and heat treated material (clones 2 and 5), and 2 Aledo clones were tested for production, has been completed. Over a three-year period clone 2 produced the most export quality grapes and the most grapes with a minimum of seedless berries. This clone is now being released to the industry as best available material. The heat treated clone 5 has already been certified as nuclear stock and is being propagated by SAPO.

The goal of the facet, namely to obtain and release a good New Cross clone, has been attained and the facet is now being terminated. The release of clone 2 is being announced in Information Bulletin No. 467.

TABLE GRAPES

UP-GRADING

(S)WP.244/5: EVALUATION OF TABLE GRAPE CULTIVARS AND SELECTIONS: SELECTION OF THE TABLE GRAPE CULTIVAR ALMERIA. 1969-1981
E.W. Mostert

An experiment has been completed in which 19 Almeria clones, one of which included standard and heat treated material (clone 13), and 9 cross selections (Rosaki x Almeria) were tested for production.

TABLE GRAPES

Over a three-year period clone 2 produced the largest total mass as well as export quality mass of grapes. The export production of this clone over the second and third crop was more than four times the industry average. Clone 2 is now being released to the industry as best available material. It has already received heat treatment and is now being indexed. In due course it will be released to nurserymen under the S. A. Superplant Scheme by SAPO.

The goal of the facet, namely to obtain and release a good Almeria clone, has been obtained and the facet is now being terminated. The release of clone 2 is being announced in Information Bulletin No. 466.

TABLE GRAPES

UP-GRADING

(S)WP.244/6: EVALUATION OF TABLE GRAPE CULTIVARS AND SELECTIONS: SELECTION OF THE TABLE GRAPE CULTIVAR GOLDEN HILL. 1973-1981
A.J. Hugo

During the past four years eighteen selected Golden Hill clones were compared with regard to performance on the Hex Valley Experimental Farm. During this period the crop was very poor in spite of efforts to improve it.

No outstanding clone could be identified and the facet is now being terminated without the release of a clone.

TABLE GRAPES

WATER REQUIREMENTS

(S)WP.254/3: THE WATER RELATIONSHIPS OF TABLE GRAPES, POME AND STONE FRUIT: SOIL MOISTURE DISTRIBUTION UNDER DRIP IRRIGATION IN SOILS OF THE WESTERN CAPE. 1975-1981
F.C. van Rooyen, P.C. van Rooyen and I. Levin

In laboratory experiments the flow and distribution of water in horizontal and vertical columns, using two soils of different texture, were investigated. The effects of continuous versus intermittent application (periods of 10 min of application alternated with 10 min of no application) of water to the soils were evaluated in terms of wetting front advance, cumulative infiltration and soil moisture content. In the vertical columns, using intermittent water application, the advance of the wetting front and cumulative infiltration was decreased and behaved as if the average water application rate were being applied continuously. The same decrease was found with horizontal columns, but to a considerably smaller extent. In effect, these decreases would change the shape of the wetted soil volume in favour of the lateral direction when using point-source irrigation. The decrease in vertical water movement can also have favourable implications with respect to water and nutrient losses beneath the root zone. By making use of intermittent water application, it is also possible to use high discharge emitters while still obtaining low rates of water application. In the medium textured soil the intermittent water application caused a significant decrease in soil moisture content in the wetted zone. This implies improved aeration in heavier textured soils.

In further laboratory and field experiments, a comparison was made between the prediction of soil moisture distribution by a computer simulation model, and the actual experimentally determined distribution. A generally good agreement was found between computed and experimental data, proving the usefulness of the model for routine work in this respect. When the model was used for predictions regarding soil moisture distribution, it was found that water applied to a sandy soil at rates of 2, 4 or 8ℓ/h continuously, resulted in a loss of 26% of the applied amount beneath the root zone. Application rates of 1ℓ/h applied continuously or 2ℓ/h applied intermittently resulted in only a 12% loss. The horizontal distribution of water was not significantly affected by these treatments. The pulse or intermittent application can therefore replace the advantageous low (1ℓ/h) application rate while to a large extent avoiding the difficulties of blocking of outlets by maintaining a high (2ℓ/h) discharge rate.

After extending the computer simulation model to incorporate even higher application rates of up to 9ℓ/h, it was found that the 3ℓ/h pulsed discharge rate can successfully replace the 1,5ℓ/h continuously applied rate, allowing a larger emitter orifice with reduced blocking problems, while still maintaining sufficient water in the root zone. At 9ℓ/h, however, the differences between the pulsed and continuous

treatments were insignificant.

The results collected so far have solved the problems as set out to a large extent, but only for homogeneous soils. Research has already commenced on collecting similar results for heterogeneous soils and, especially, on writing a totally new and improved simulation model for handling any soil type, heterogeneous or homogeneous. The writing of such a model is, however, a difficult and time-consuming task involving high mathematics, but has progressed well in this last year. This task is now nearing completion and it is imperative that work on it should continue so as not to waste previous efforts. Parallel to this, practical experiments should continue in order to collect data for the verification of the new model.

WINE GRAPES

CHEMICAL CONTROL

(S)WI.50/1: CHEMICAL WEED CONTROL IN VINEYARDS: PHYTOTOXICITY OF HERBICIDES FOR CERTAIN GRAPE CULTIVARS. 1977-1981
C.J. Smit

Soil residual safety of herbicides is a critical factor regarding acceptibility for use in vineyards. The phytotoxicity of 71 herbicides was investigated using one-year-old vines as test plants. Fifty-two of these herbicides had a soil residual safety as good as or better than that of simazine (3,75 kg/ha). As a large group the dinitro-anilines has the lowest soil residual phytotoxicity.

Phytotoxicity of herbicides was also determined after thorough wetting of aerial parts of actively growing vines. This is, however, not regarded as critical because it is normally avoided by using directed sprays. Combination of these phytotoxicity results with those obtained in another research project on the efficiency of weed control by the safer herbicides will lead to the selection of the best herbicides for grapevines.

WINE GRAPES

CROP SCIENCE

(S)WI.46/6(i) and (iii): ROOTSTOCKS FOR SOUTH AFRICAN VINEYARDS: COMPARATIVE STUDY OF ROOTSTOCK CULTIVARS WITH CHENIN BLANC AS THE SCION CULTIVAR ON THREE DIFFERENT SOIL TYPES IN THE VREDENDAL AREA. 1971-1981
P.G. de Bruyn

Trial (i)

The object of this study was to evaluate the performance of ten rootstock cultivars (*viz* 99 Richter, 110 Richter, Ramsey, 143B Mgt, 101-14 Mgt, Rupestris du Lot, C Metallica, 333 3306 C, Jacquez and ungrafted Chenin blanc) with Chenin blanc as the scion cultivar on silty soil in the Vredendal area. The trial was executed on a private farm. Each treatment was replicated four times in randomised blocks. Because of special summer pruning pratices which lead to great losses in winter pruning mass, no significant differences in vegetative growth between rootstocks could be measured.

Results of crop mass show that only Jacquez differs significantly from the other treatments and should not be recommended as a possible rootstock for this soil type. The only rootstock to be recommended with certainty is 99 Richter with Ramsey as the second choice.

Trial (iii)

In this trial 13 rootstocks (*viz* 110 Richter, 99 Richter, Ramsey, C Metallica, 101-14 Mgt, De Waal, Rupestris du Lot, 3306 C, 143B Mgt, Teleki, Jacquez, Fairy and 333) were evaluated for their adaptability to sandy soils under the climatic conditions prevailing for the Vredendal area. Each treatment was replicated four times in randomised blocks.

According to the pruning mass Ramsey, C Metallica and Rupestris du Lot, although not always significantly, are the most vigorous rootstocks.

Results of crop mass show no significant difference between the rootstocks 110 Richter, C Metallica, 99 Richter, Ramsey, 101-14 Mgt, De Waal and Rupestris du Lot. The use of rootstocks Fairy and 333 results in significantly less crop mass than the above-mentioned group.

The only rootstocks to be recommended with certainty are Ramsey, 110 Richter and 99 Richter. This study furthermore showed that Jacquez has no chance as a rootstock for South African vineyards.

WINE GRAPES

CROP SCIENCE

(S)WI.46/14: ROOTSTOCKS FOR SOUTH AFRICAN VINEYARDS: A COMPARATIVE STUDY WITH DIFFERENT ROOTSTOCK CULTIVARS WITH CHENIN BLANC AS SCION CULTIVAR ON A DUNDEE SOIL TYPE ON THE EXPERIMENTAL FARM AT OUDTSHOORN. 1975-1981

P.G. de Bruyn

Twelve rootstocks with Chenin blanc as scion cultivar were planted in a randomised block design on a Dundee soil type under flood irrigation in the Oudtshoorn area. The chemical characteristics of the soil induced such variations in treatments and replications that no significant difference between treatments was found seven years after planting. These variations seem to be enhancing as time progresses and therefore this trial will be replaced by one consisting of heat treated material of both scion and rootstock cultivars.

This new trial will be planted on soil of which the chemical properties will be determined beforehand.

WINE GRAPES

CROP SCIENCE

(S)WI.46/16: ROOTSTOCKS FOR SOUTH AFRICAN VINEYARDS: AFFINITY TRIAL WITH NEW ROOTSTOCKS. 1975-1982

P.G. de Bruyn

Nine imported and four newly bred rootstocks grafted with six different scion cultivars were planted in an affinity trial with a randomised block design. Non-clonal material with unknown virus status was originally used and it is well known that both genetic factors and virus infection can effect compatibility. The results of this trial will therefore have no bearing on the clonal, heat treated material being introduced into the industry at present. No valid conclusions can be drawn from the present experiment and therefore this trial has been terminated and will be replaced by one consisting of heat treated clonal material of both scion and rootstock cultivars.

WINE GRAPES

CROP SCIENCE

(S)WI.54/2: SOIL PREPARATION STUDIES: THE EFFECT OF SOIL PREPARATION DEPTHS AND ADDITIONS OF ORGANIC MATTER ON GROWTH, PRODUCTION AND QUALITY OF WINE GRAPES (ROBERTSON). 1967-1981

D. Saayman and L. van Huyssteen

The effect of depth and method of soil preparation and of organic material additions on the performance of Chenin blanc/101-14 Mgt vines planted on a Hutton/Sterkspruit soil, was studied in the Robertson irrigation area. Measurements of shoot, root and crop mass and the sugar and acid content of the must were used as criteria for vine performance while soil moisture, soil density and soil mechanical resistance measurements were used to characterise the effect of treatments on soil properties.

WINE GRAPES

The general feebleness or even lack of response of the vines to different organic material additions and to different methods and depths of soil preparations, is evident from Fig. 1 and 2 and Tables 1 and 2. The general root distribution as affected by the method of soil preparation as shown in Fig. 3. also shows smaller differences than would have been expected. The lack of significance in the results could eventually be traced back to soil variation and the inefficiency of soil preparation implements to work up to the desired depth as shown in Table 3. However, once these complicating factors were identified and taken into consideration, several important findings could be pointed out:

- The use of straw or compost in quantities used in this investigation, clearly did not improve vine performance and is a costly operation which cannot be recommended on these Hutton/Sterkspruit soil associations.
- Clear indications were found that soil depth did have an effect on vine performance as shown in Fig. 4, and it would appear that a minimum soil depth of 70-80 cm should be the aim of soil preparation on the soils concerned. The delve plough also seems to be more efficient than the ripper.
- The gravimetric type of root studies used, proved to be too laborious to be of general use. The more qualitative studies on root distribution in exposed profile pit walls (Fig. 3) were found to be sufficiently informative and more practical.
- In characterising soil physical properties and soil depth, a neutron/gamma probe gave useful results but it was the continuous recording penetrometer that proved to be an invaluable tool in identifying restricting soil layers and in giving a qualitative as well as a quantitative measure of soil conditions (Fig. 5).

Although this investigation confirmed the value of adequate soil depth, it also pointed out the lack of proper norms according to which decisions could be made concerning the need and intensity of soil preparation for different soil conditions. Further research concerning this aspect is needed.

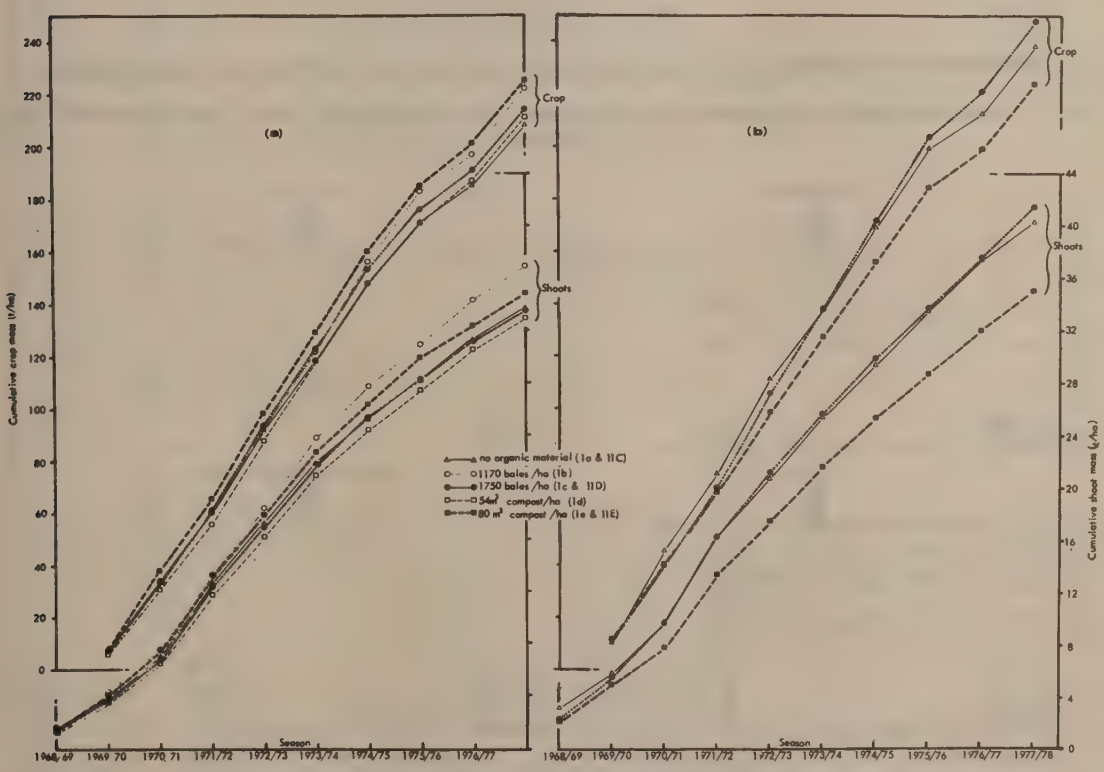

FIG. 1 - Effect of organic material on the yield and shoot mass of Chenin blanc/101-14 Mgt, Robertson: (a) Experiment I; (b) Experiment II

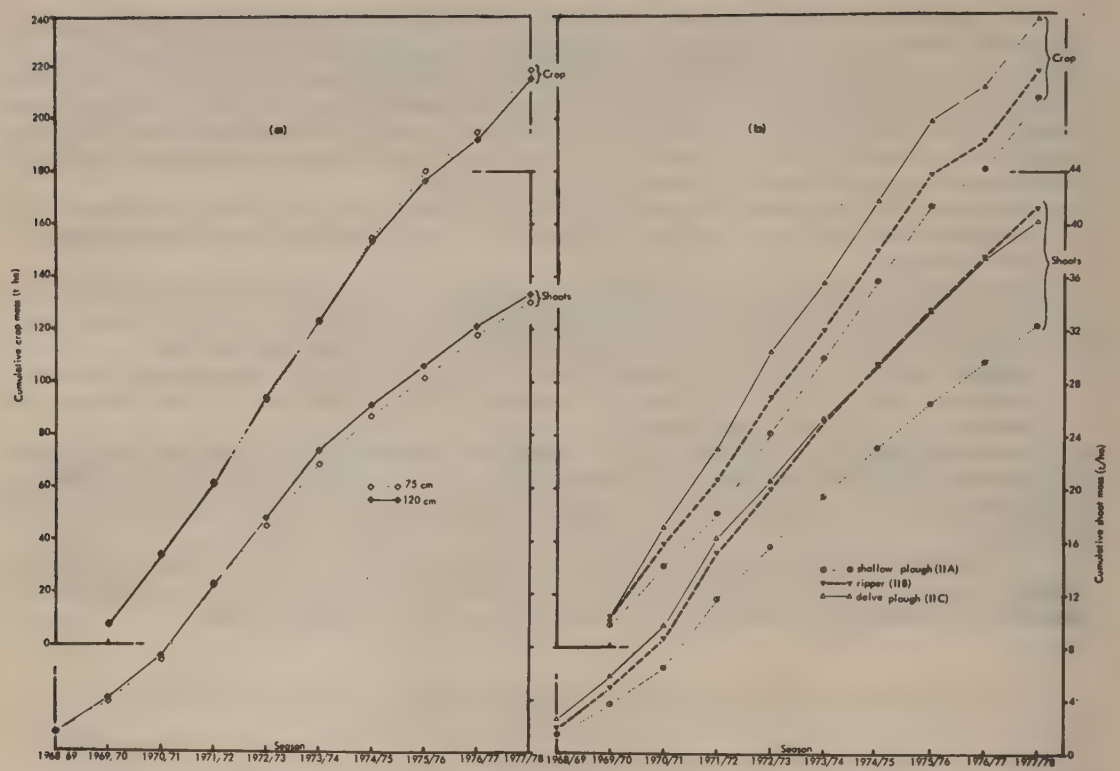

FIG. 2 - Effect of (a) depth and (b) method of soil preparation on the yield and shoot mass of Chenin blanc/101-14 Mgt, Robertson

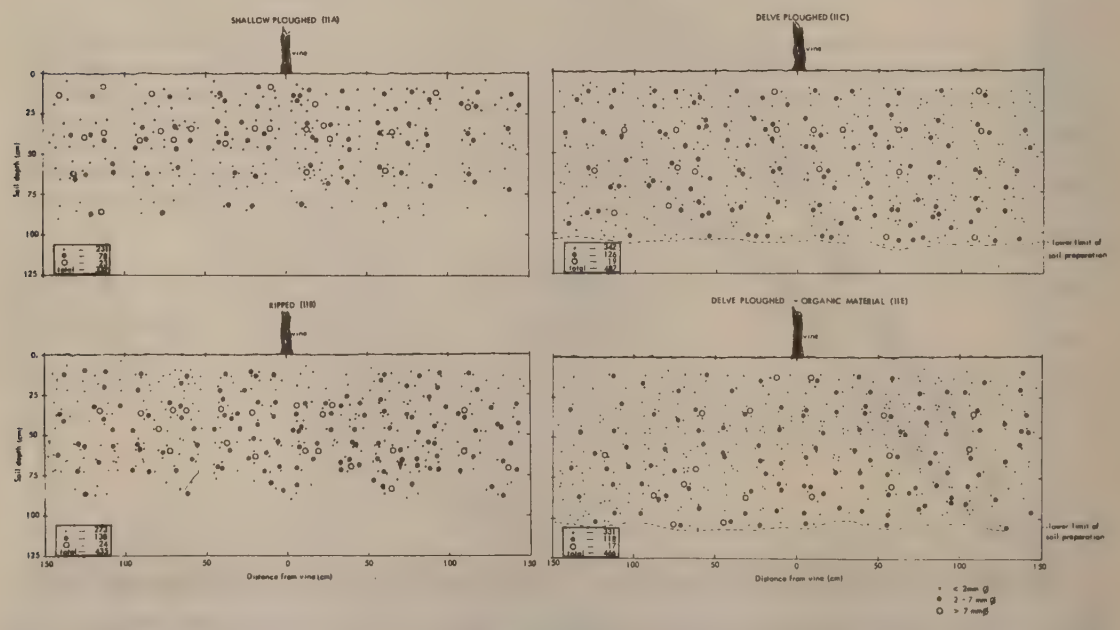

FIG. 3 - Amount and distribution of roots in profile pit wall as affected by different methods of preparation of a Hutton/Sterkspruit soil, Robertson

TABLE 1 - Effect of organic material (OM) amendments and soil preparation depths and methods on the cumulative mass (t/ha) of shoots of Chenin blanc/101-14 Mgt. in the Robertson area

Treatment	Season									
	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78
75 cm delving depth	1,5	3,8	7,0	12,7	17,1	21,8	25,4	28,3	31,6	34,1
120 cm delving depth	1,4	4,0	7,2	12,7	17,7	22,8	26,2	29,2	32,2	34,6
Significance/(D value)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Ia-no OM	1,3	3,9	7,0	12,6	17,2	21,8	25,1	28,1	31,2	33,7
Ib-1 170 bales/ha	1,7	4,3	7,6	13,3	18,4	23,8	27,7	30,9	34,3	37,9
Ic-1 750 bales/ha	1,4	3,7	6,8	12,3	16,9	21,8	25,2	28,1	31,1	33,5
Id-54 m^3 compost	1,2	3,5	6,5	11,7	16,2	20,9	24,4	27,4	30,5	32,9
Ie-80 m^3 compost	1,5	4,1	7,6	13,3	17,9	22,7	26,3	29,2	32,2	34,8
If-1 170 bales + 54 m^3 compost	1,5	4,0	7,3	13,1	17,8	22,7	26,1	29,0	32,0	34,3
Significance/(D value)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
IIA-shallow ploughed	1,4	3,7	6,5	11,7	15,7	19,5	23,2	26,5	29,7	32,4
IIB-ripped	1,8	5,0	8,7	15,2	20,1	25,1	29,5	33,5	37,7	41,4
IIC-deep delved + no OM	2,6	5,8	9,7	16,3	20,7	25,4	29,4	33,5	37,4	40,3
IID-deep delved + 1 750 bales	2,3	5,5	9,7	16,3	21,1	25,7	29,9	33,8	37,6	41,4
IIE-deep delved + 80 m^3 compost	2,1	4,9	7,8	13,3	17,5	21,6	25,4	28,7	32,0	35,0
Significance/(D value)	*(1,0)	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS = Not significant; * = Significant ($P < 0,05$)

TABLE 2 - Effect of organic material (OM) amendments and soil preparation depths and methods on the cumulative mass (t/ha) of grapes of Chenin blanc/101-14 Mgt. in the Robertson area

Treatment	Season								
	1969/70	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78
75 cm delving depth	8,3	35,2	61,8	93,5	123,0	155,2	180,2	194,9	219,1
120 cm delving depth	7,5	33,9	61,2	94,4	123,1	153,5	176,6	192,1	214,9
Significance/(D value)	NS	NS	NS	NS	NS	NS	NS	NS	NS
Ia-no OM	8,4	33,7	60,3	91,7	118,7	148,4	170,6	184,9	207,9
Ib-1 170 bales/ha	7,5	33,8	60,2	92,5	121,8	156,0	192,9	197,3	222,0
Ic-1 750 bales/ha	8,0	33,7	61,2	93,5	122,9	153,2	176,4	191,1	213,9
Id-54 m^3 compost/ha	6,4	30,8	55,8	87,9	117,7	148,5	171,3	187,3	211,0
Ie-80 m^3 compost/ha	8,4	38,3	65,6	98,6	128,9	160,2	185,1	201,1	224,7
If-1 170 bales + 54 m^3 compost/ha	8,7	36,8	65,6	99,6	128,3	160,3	184,5	199,6	222,6
Significance/(D value)	NS	NS	NS	NS	NS	NS	NS	NS	NS
IIA-shallow ploughed	8,5	30,8	51,1	81,2	109,7	138,5	167,3	181,4	208,0
IIB-ripped	11,2	39,3	63,9	94,7	120,6	149,9	179,3	192,0	217,7
IIC-deep delved + no OM	10,6	45,9	75,4	111,6	138,0	169,4	199,3	212,2	238,1
IID-deep delved + 1 750 bales	11,8	40,0	70,3	106,3	138,2	172,0	203,7	220,9	247,5
IIE-deep delved + 80 m^3 compost	11,9	40,5	68,4	99,2	127,7	156,3	184,7	199,1	223,9
Significance/(D value)	NS	*(14,04)	**(17,3)	*(24,0)	*(23,7)	*(27,9)	*(36,4)	*(38,0)	(40,6)

NS = Not significant; * = Significant ($P < 0,05$); ** = Highly significant ($P < 0,01$)

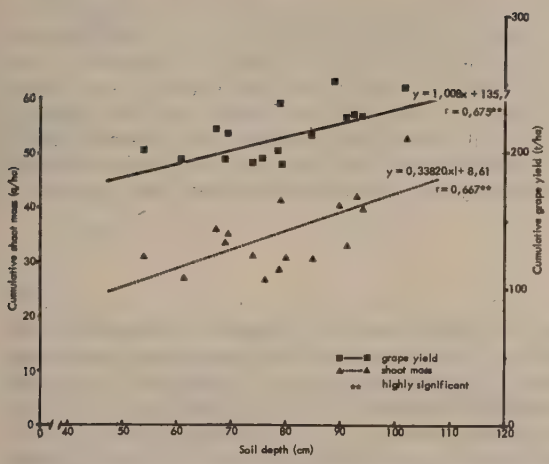

FIG. 4 - Relationship between soil depth and vine performance: Hutton/Sterkspruit, Robertson

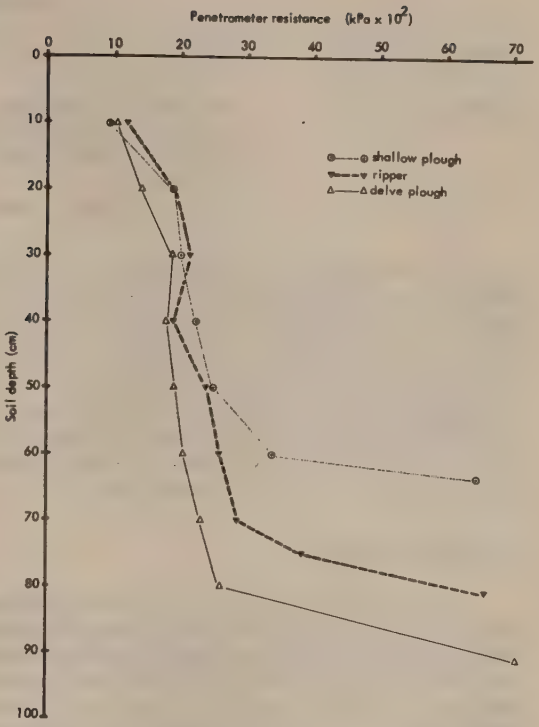

FIG. 5 - Effect of method of soil preparation on the mechanical resistance of a Hutton/Sterkspruit soil to a continuous reading penetrometer

TABLE 3 - Mean depth* of a Hutton/Sterkspruit soil, Robertson as affected by depth of delve ploughing

Treatment	Depth at which penetrometer reading exceeded 70 kPA x 10 (cm)					
	Repetition					
	I	II	III	IV	Mean	LSD
75 cm ploughing depth	75,8	78,6	73,9	80,9	76,9	NS
120 cm ploughing depth	84,9	68,8	77,7	89,0	81,5	

*Each value is the mean of 9 determinations per plot

Publication

SAAYMAN, D. & VAN HUYSSTEEN, L., 1980. Soil preparation studies: I. The effect of depth and method of soil preparation and of organic material on the performance of *Vitis vinifera* (var. Chenin blanc) on Hutton/Sterkspruit soil. *S. Afr. J. Enol. Vitic* 1(2), 107-121.

WINE GRAPES

CROP SCIENCE

(S)WI.56/4: THE EFFECT OF TRELLISING SYSTEMS AND RESULTING MICRO-CLIMATE ON THE CONSUMPTIVE WATER USE, GRAPE COMPOSITION AND WINE QUALITY OF A CHENIN BLANC VINEYARD. 1977-1981

J.L. van Zyl and L. van Huyssteen

The investigation was conducted in an irrigated 12-year-old Chenin blanc vineyard, trellised on different systems (Zeeman, 1975). Four trellising systems at the same planting distance were utilised, *viz* (a) bush vines; (b) 3-wire Perold; (c) 5-wire lengthened Perold; and (d) 1,7 m slanting trellis. Soil moisture content was measured in the different trellising systems with the aid of a neutron moisture meter. Moisture measurements commenced at bud burst and continued at weekly intervals until leaf drop. Berry samples were also collected on a weekly basis, crushed, and the must analysed. Shoot mass was measured at pruning and grape yield, bunch rot and shading of the soil surface under the different trellising systems, at harvesting. Parallel to the weekly soil moisture determinations and berry sampling, micro-climatic elements were measured, starting at flowering and continuing until harvest. Relevant soil and root studies were carried out on the experimental site.

Consumptive water use

The root distribution of vines for the different trellising systems was mainly determined by soil physical conditions and was uniform with depth (Fig. 1). The slanting trellis had significantly more roots than the other three systems, confirming the belief that a large vegetative growth is balanced by a large root system. The tendency (not significant) for the number of roots in the other trellising systems was: lengthened Perold > Perold > bush vines. However, there seems to be no relationship between root density and rate of water use by the vines. The highest crop factors (seasonal average of 0,31) were found in the bush vines (Table 1). For the slanting trellis, lengthened Perold and Perold systems average crop factors of 0,26, 0,24 and 0,21, respectively, were obtained. The consumptive water use of the latter systems was, therefore, in the same sequence as that expected from their vegetative growths. Crop factors for the bush vines are unexpectedly high considering the fact that its pruning mass as well as its grape yield was respectively, 51,0 % and 27,5 % lower than those of the slanting trellis (Table 2). The reason for the higher evapotranspiration rate in bush vines compared to the other systems, should be sought in the micro-climatic environment of the plant. A higher temperature regime amongst the bush vines led to a faster transpiration rate, while more air movement enhanced both transpiration and evaporation (see discussion on micro-climate). Another important contributing factor was percentage shading of the soil surface (Fig. 2). This was 28,5 % more in the case of the slanting trellis than between the rows of the bush vines. The shading patterns during the course of the day are functions of configuration of the trellised vines. Under the conditions of this experiment it became clear that it is mainly the micro-climatic environment that controls evapotranspiration and not the root system or the direct effect of plant size.

Incidence of bunch rot

Bush vines were more prone to bunch rot than the larger trellising systems (Table 3). There seems to be a direct correlation between total nitrogen as well as arginine content of the must and the incidence of bunch rot. The reason for the higher arginine and total N content of the bush vines is not quite clear. Preliminary results concerning different cropping levels have shown a higher yield to be less prone to bunch rot infection. This is in agreement with field observations, but the mechanisms involved need further study.

The micro-climate

The lowest air movement (49 % less than in bush vines) was measured in the lengthened Perold systems due to its hedge-type growth pattern. Somewhat less wind (11,5 %) occurred in the slanting trellis than among the bush vines which offered the lowest resistance to air movement.

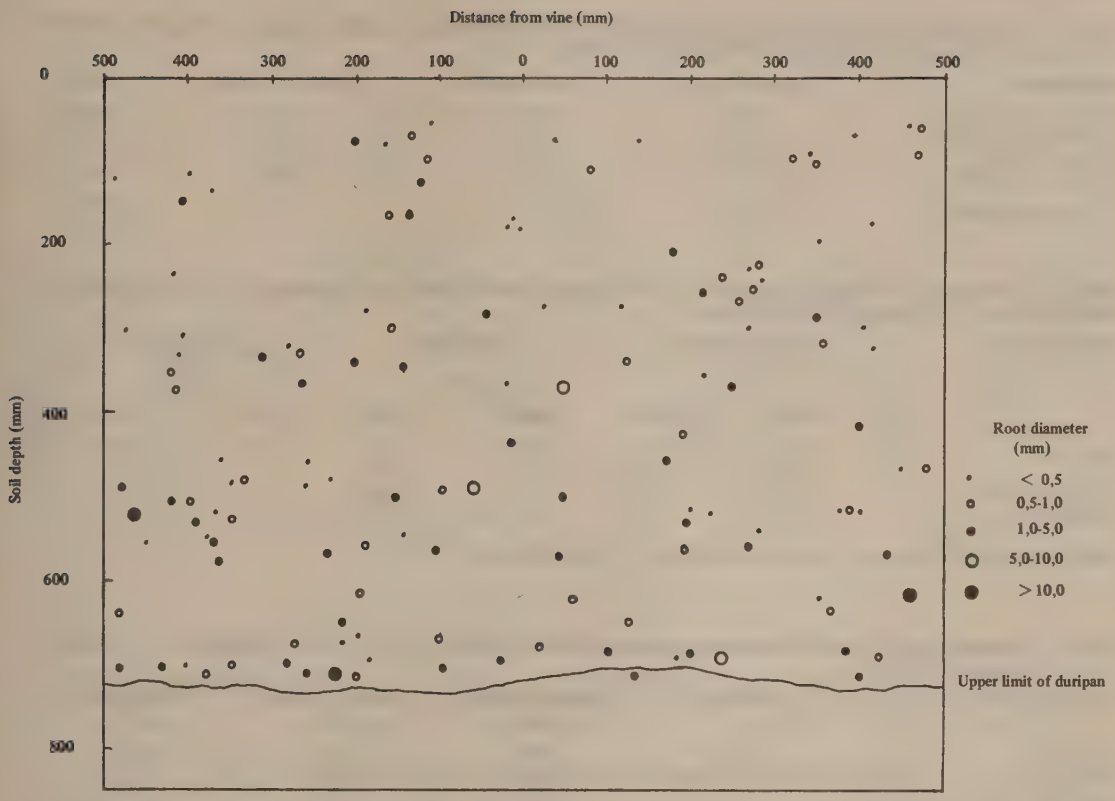

FIG. 1 - Root distribution of Chenin blanc/101-14 Mgt. bush vines - Oakleaf soil, Robertson

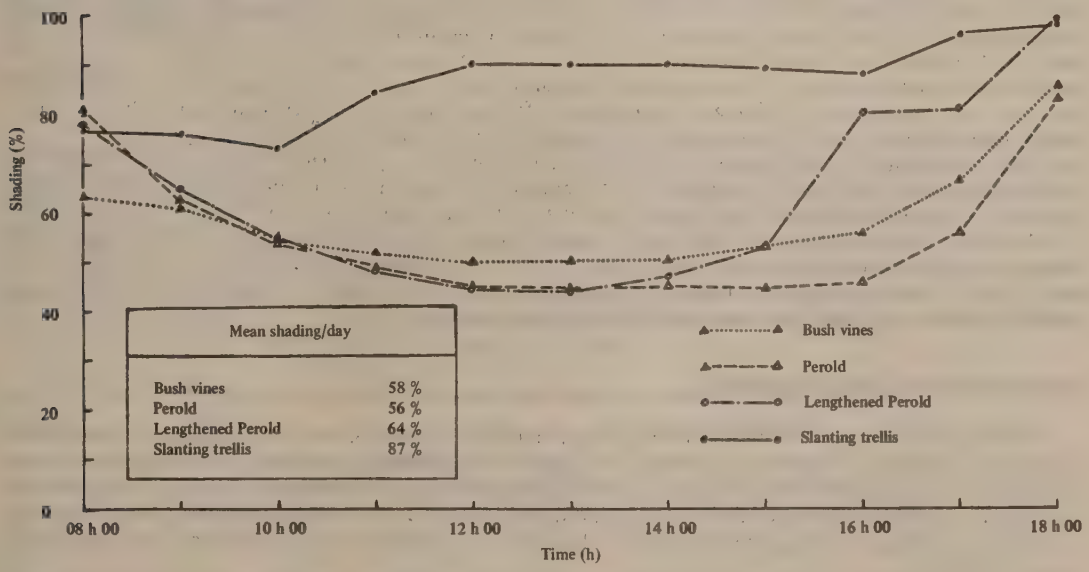

FIG. 2 - Shading of soil surface by Chenin blanc on different trellising systems during the course of the day, Robertson

TABLE 1 - Crop factors for Chenin blanc/101-Mgt on different trellising systems, calculated from evapotranspiration measurements and Class A pan evaporation, during the 1977/78 season, Robertson

Growth stage	Bush vines	1,7 m slanting trellis	Lengthened Perold	Perold
Bud burst - flowering	0,38	0,28	0,23	0,20
Flowering and fruit set	0,33	0,28	0,27	0,24
Fruit set - véraison	0,31	0,28	0,27	0,22
Véraison - harvesting	0,23	0,18	0,20	0,16
Bud burst - harvesting	0,31	0,26	0,24	0,21

TABLE 2 - Grape yield and vegetative growth data in a Chenin blanc vineyard before the commencement of the trial (averages for 1969-1973, Zeeman, 1975) and for the 1977/78 season

Trellising system	Grape yield at 20 °B t/ha		Pruning mass kg/vine		Grape/shoot ratio	
	1969-73	1977/78	1969-73	1977/78	1969-73	1977/78
Bush vines	12,32	14,72*	1,09	1,21a	3,84	4,74
Perold	28,36	26,05b	1,35	1,09a	7,19	8,77
Lengthened Perold	31,27	26,30b	1,64	1,82ab	6,56	4,97
Slanting trellis	42,05	23,59b	2,26	2,47b	6,58	3,54

*Numbers not followed by the same letters, differ significantly from each other at the 5 % level

TABLE 3 - Incidence of botrytis rot in different trellising systems and corresponding arginine and total nitrogen content of must of Chenin blanc grapes at Robertson

Trellising system	Botrytis rot %	Arginine in must ppm	Total N in must ppm	Production t/ha
Bush vines	46	290	550	14,7
Slanting trellis	40	205	400	26,1
Lengthened Perold	34	185	362	26,3
Perold	32	115	367	23,6
D value ($P < 0.05$)	9,8			

Noticeable differences among bunch and ambient air temperatures of the three trellising systems occurred mostly between 10 h 00 and 15 h 00 to 16 h 00 (Fig 3). From véraison till harvesting, bunch temperatures at 12 h 00 were on average 6,73 °C higher in the bush vines than in the lengthened Perold and 5,71 °C higher than that of the slanting trellis. In the first case, high temperatures are the result of bunches being more exposed to the sun. Bush vines also receive more reflected heat from the soil surface than vines on longer stems. Although temperature differences were sometimes small and valid for short periods only, its effect on grape composition is cumulative and should therefore not be ignored.

Soil temperature was considered to be an important parameter due to its effect on evapotranspiration and grape composition. A marked lowering in soil temperature occurred after irrigations. Seasonal averages of soil temperature at the 200 mm depth were 24,6 °C, 23,7 °C and 23,3 °C for the bush vines, lengthened Perold and slanting trellis, respectively. At the 500 mm depth, soil temperature in the lengthened Perold was highest *viz* 23,3 °C in comparison with 22,7 °C in the bush vines and 21,7 °C in the slanting trellis. Present knowledge concerning the effect of temperature on plant roots is still too limited to relate these small differences to plant reaction.

Grape characteristics and composition

Results of berry growth differed little amongst trellising systems. Contrary to the expectation when temperature regimes are taken into account, the sugar content of the bush vines was much lower than those of the other systems. This deviation started at véraison and continued till harvesting even though grapes from the bush vines were allowed to ripen 8 days longer (Fig. 4). Active vegetative growth observed on bush vines during ripening, probably due to the effect of a lighter crop, may offer an explanation for this phenomenon.

Although differences in pH of the must among trellising systems were small, values for the bush

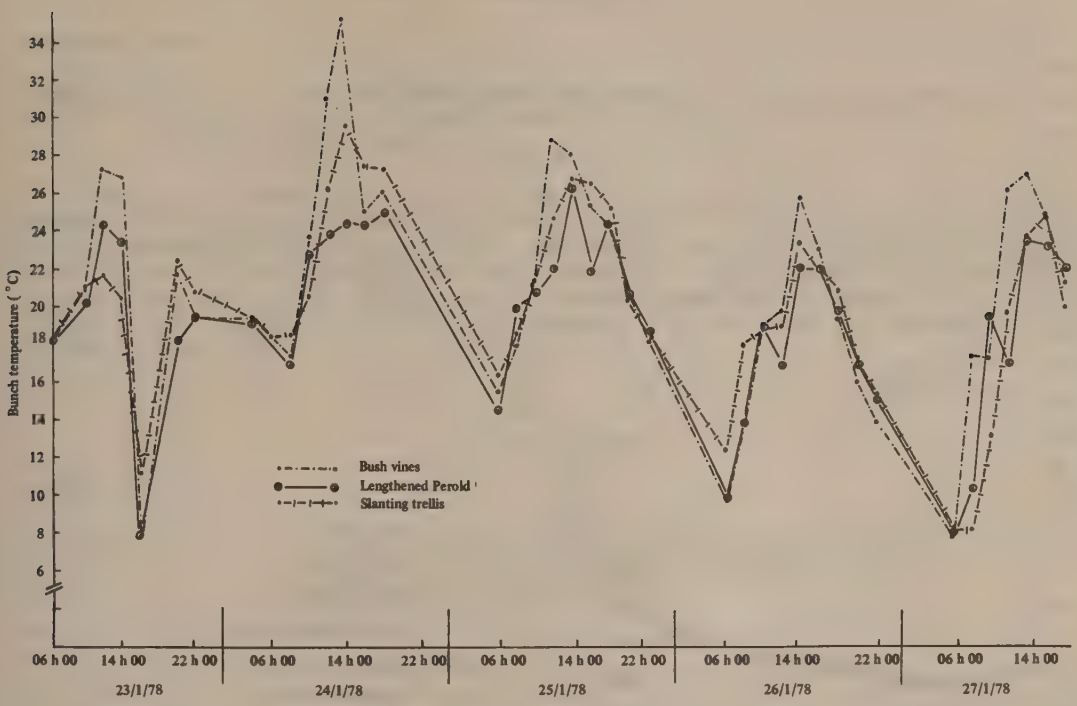

FIG. 3 - Diurnal fluctuations in bunch temperatures of three different trellising systems

vines were consistently higher than those of the three larger systems. There was not much difference in the tartaric acid content among systems and the differences in total titratable acidity are due to differences in malic acid content which were 4,13; 5,31; 5,14 and 5,91 g/ℓ for the bush vines, Perold, lengthened Perold and slanting trellis, respectively, at harvesting. According to literature the malic acid content of the must reflects temperature regimes in the bunches.

Wine quality

Differences in grape composition of the trellising systems were not reflected in wine quality. The organoleptic wine quality of the bush vines was significantly better than that made from the slanting trellis. A closer inspection of score cards revealed no single property of the experimental wine other than colour to explain the above-mentioned results. Only grapes free from bunch rot were used for wine making in this study. A re-evaluation of data previously obtained in the same vineyard, showed quite clearly that the incidence of bunch rot played a major role in determining differences in wine quality among the trellising systems (Table 4). It may therefore be concluded that under these specific viticultural and climatic conditions, the trellising systems apparently affected wine quality mainly via their influence on bunch rot and not via grape composition and micro-climate.

TABLE 4 - Data on the incidence of bunch rot and the organoleptic evaluation of wine quality of Chenin blanc*

Season	Bush vines		Perold		Lengthened Perold		Slanting trellis	
	Botrytis	Wine quality	Botrytis	Wine quality	Botrytis	Wine quality	Botrytis	Wine quality
	%	%	%	%	%	%	%	%
1970	45	<35	25	59	10	76	5	77
1971	13	55	5	54	3	54	7	54
1972	25	38	7	63	13	48	26	42

*Zeeman, 1975

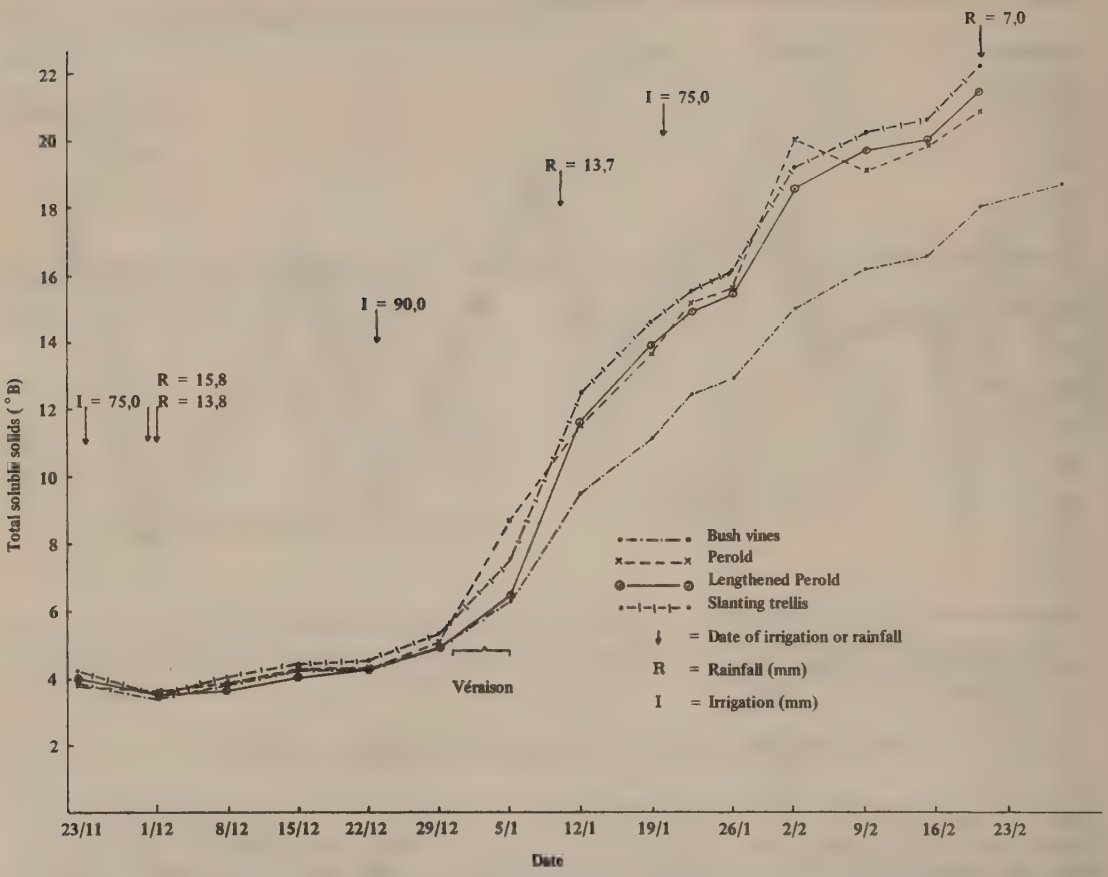

FIG.4 - Changes in sugar concentration with time in Chenin blanc grapes from different trellising systems

Reference

ZEEMAN, A.S., 1975. Plantwydtes en stelsels van oplei vir S.A. wyndruifwingerde: Die invloed van verskillende plantwydtes en opleibehandelings met Chenin blanc as die bostokcultivar op die grootte en gehalte van die oes te Robertson-proefplaas. Final Report, Project (S)WI.45/3, O.V.R.I., Private Bag X5026, Stellenbosch.

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VAN ZYL, J.L. & VAN HUYSSTEEN, L., 1980a. Comparative studies on wine grapes on different trellising systems: I. Consumptive water use. *S. Afr. J. Enol. Vitic.* 1(1), 7-14.

VAN ZYL, J.L. & VAN HUYSSTEEN, L., 1980b. Comparative studies on wine grapes on different trellising systems: II. Micro-climatic studies, grape composition and wine quality. *S. Afr. J. Enol. Vitic.* 1(1), 15-25.

WINE GRAPES

CROP SCIENCE

(S)WI.59/1: ESTABLISHING AND RENEWING OF VINEYARDS: RENEWAL OF AN OLD CABERNET VINEYARD. 1977-1981
F.S. de Villiers

The detrimental effect of wood rot fungi on the aerial parts of vines is a serious problem of especially older vineyards in the Western Cape. Various methods of renewing an affected vineyard without replanting were studied. No satisfactory results were obtained with the three methods used, *viz* girdling above the graft union to stimulate water shoots; cutting the trunk *ca* 30 cm above ground level to stimulate water shoots; and cutting the trunk *ca* 30 cm above ground level and grafting by means of the T bud method. No significant differences in percentage survival between the above-mentioned treatments and the control were found.

WINE GRAPES

CROP SCIENCE

(S)WI.67/1: EFFECT OF WINTER AND SUMMER PRUNING ON VINE PERFORMANCE: PRUNING METHODS FOR CABERNET SAUVIGNON. 1978-1981
E. Archer

Comparable production levels as in the case of any long-bearer pruning system can be reached when spur pruning is applied on Cabernet Sauvignon. This is mainly possible because of higher budding percentage on the spurs than on the long bearers combined with similar fertility of the bud on spurs and long bearers. These results make it possible to recommend spur pruning on Cabernet Sauvignon in practice whereby saving on pruning labour is realised.

WINE GRAPES

CROP SCIENCE

(S)WI.67/2: EFFECT OF WINTER AND SUMMER PRUNING ON VINE PERFORMANCE: DESUCKERING OF VINES. 1978-1981
A.J. Beukes

The compensating capacity of a vine for the loss of reproductive and vegetative growth during desuckering originates in higher fertility, bigger bunches and thicker shoots. No effect on wine quality was shown while a more effective disease control with desuckering seemed possible. A more effective utilisation of farm labour in terms of distribution is possible when desuckering is applied.

WINE GRAPES

NUTRITION

(S)WI.51/5: SOIL AND FERTILISATION STUDIES WITH WINE GRAPES: FERTILISATION EXPERIMENT WITH PALOMINO (WHITE FRENCH) GRAPEVINES (LUTZVILLE). 1973-1980

D. Saayman and W.J. Conradie

The effect of two levels of conventional fertiliser applications on the performance of Palomino grapes on the fertile soil of the Lutzville area, was studied in an existing vineyard on the O.V.R.I. Experimental Farm. Shoot mass and yield measurements were used as indicators of vine performance. Soil, foliar and must analyses were also carried out.

The soil concerned was a mixture between low lying, dark coloured, alluvial soils and more sandy, red material derived from the also commonly occurring "dorbank" (duripan) soils. According to the analyses data, this soil was characterised by a high phosphorus and potassium content of *ca* 350 ppm and 400 ppm (1,01 me %), respectively. No convincing evidence of important changes in soil reserves of P and K after four years of fertilisation could be found. New silt deposits in the experimental vineyard, due to a flood during 1976, rendered further soil analyses futile.

The changes in shoot and crop mass over a nine-year period did not differ significantly between fertiliser treatments, but a tendency towards a response in the case of shoot mass was evident and was significant at a 10 % level when the cumulative shoot mass was used as criterion. These results, together with field observations of visual N deficiency symptoms, indicated a slight response to N being present in the fertilisers applied. Foliar and must analyses were generally very disappointing as a means of reflecting the effect of fertiliser treatments. This was especially true for P and K but seems to be the result of the luxurious P and K supply naturally available to the vines prior to differential fertiliser application.

The serious decline in the performance of ungrafted vines due to phylloxera infestation, illustrates the magnitude of the effect of such limiting factors in comparison with the relatively feeble effect of fertilisation on these soils.

Calculations showed that a crop of 40 t/ha, as produced by grafted vines, removed 42 kg N, 8 kg P and 48 kg K annually. These amounts were more than adequately compensated for by both fertiliser treatments and in the case of unfertilised vines, it was conservatively calculated that the natural reserves of P and K in the soil should be sufficient to support a production of 40 t/ha for at least 20 years.

Concerning nitrogen, results obtained and calculations made, indicate that the soil concerned is on the borderline in its ability to supply the vines with sufficient N.

These findings led to the conclusion that P and K fertilisation is unnecessary on soils of similar chemical properties and that even N should be applied judiciously, especially on the dark alluvial soils of this region. As a tentative guideline an amount of 90 kg N/ha per year is suggested for mass producing vineyards of which the grapes are destined for wines for distillation.

WINE GRAPES

PESTS

(S)WI.70/2: THE CHEMICAL CONTROL OF ABOVE-GROUND INSECT AND OTHER PESTS OF WINE AND RAISIN GRAPES: CONTROL OF THE VINE MEALYBUG. 1979-1981

C.A. de Klerk

Various insecticides were evaluated in a field trial for the control of the vine mealybug, *Planococcus ficus*. The insecticides were applied with handguns at a pressure of 2 500 kPa. The whole vine, especially the bunches and trunk, was thoroughly sprayed with approximately 2,5 ℓ spray mixture per vine. Applications were made in January and data were collected during harvest. Evaluation was done by determining the presence or absence of mealybugs on each bunch per vine and the results were statistically analysed.

All the insecticides tested, *viz* fenchlorfos 40 % ec, dichlorvos 50 % ec, dimethoate 20 % wp, methidathion 40 % wp, omethoate 80 % ec, chlorpyrifos 48 % ec, carbaryl 85 % wp and methiocarb 80 % wp were found to be most effective for the control of mealybugs.

WINE GRAPES

PESTS

(S)WI.81: ABOVE-GROUND PESTS OF WINE GRAPES: DEVELOPMENT OF TECHNIQUES OF EVALUATING BIRD DAMAGE. 1980-1982

G.B. Dennill and C.A. de Klerk

Bird damage in vineyards has become increasingly significant to wine grape farmers. In order to assess bird damage in any vineyard and to evaluate control experiments, a method of determining bird damage is essential. The aim of this project was to develop such a method.

Method

Three methods of evaluating bird damage were compared: (a) counting damaged berries per bunch, (b) visually assessing damage per bunch and (c) visually assessing damage per vine. The time periods taken to implement these methods were also compared.

Results and Discussion

The losses attributed to birds feeding on wine grapes are either total removal of berries or puncturing of berries by pecking. The latter either become desiccated or become infested by secondary organisms (e.g. fungi) which often leads to loss of the entire bunches affected. The term 'bird damage' is used to include all of these cases.

(a) Assessing bird damage by counting damaged berries per bunch

A Pinotage vineyard in which bird damage occurred was selected. The vineyard was divided into 25 blocks (replicates) comprising seven rows of 20 vines each. The central six vines of the central row in each block were selected as data vines. The actual number of damaged berries in each replicate of six vines was counted. This method had the following disadvantages which rendered it unacceptable:

(1) It was very time consuming. Twelve minutes were spent by one person to collect the required data from one vine. In this particular vineyard there was a total of 150 data vines. For one person to sample all of these vines would take 30 h.

(2) Because this method is so time consuming, the total sample size was too small. The 150 data vines in this case constituted only 3,97 % of the total number of vines in this vineyard.

(3) Additional sampling of replicates adjacent to those used to obtain data, revealed that variation in bird damage was high within a small area. Because the replicates had to be so small this variation would not be accounted for.

It was therefore attempted to derive a method whereby the damage done to individual bunches could be assessed visually.

(b) Visual assessment of bird damage per bunch

The proportion of a bunch of grapes that has been damaged was expressed as a percentage of the total bunch by using the following easily distinguishable categories: 0 %; 10 %; 25 %; 50 %; 75 %; 90 % and 100 %.

Eleven bunches of Chenin blanc grapes which displayed various degrees of bird damage were selected. Five people visually assessed the damage on each bunch using the categories mentioned above. Thereafter the actual percentage of damaged berries on each bunch was calculated by counting the damaged and undamaged berries. The same procedure was followed using ten bunches of Shiraz grapes to see whether there was any difficulty using a cultivar of a dark colour and smaller berries. The results (Tables 1 and 2) show that there was no significant difference between visual and actual counts for both cultivars and that the visual method was reasonably accurate. The variation in the means of the visual assessments was attributed to the fact that some of the people used had less experience in assessing bird damage than others.

Two people who had most experience in this field were used to repeat this experiment using 50 bunches of Chenin blanc grapes and 50 bunches of Shiraz grapes. The results (Tables 3 and 4) show that no significant differences existed between the actual counts and the visual assessments and that the visual method was remarkably accurate. The more accurate results were probably obtained by using more experienced people and by the increased number of replicates.

This method of visually assessing bird damage was applied in three separate vineyard blocks. One of these blocks was in a Chenin blanc vineyard and the other two were in a Shiraz vineyard, one being on the border of the vineyard and the other being centrally situated. There were 120 vines in each block and

it was found that on average, one person spent 1,67 min per vine. This method is 86,11 % quicker than making actual counts of damaged berries in a vineyard.

(c) Visual assessment of bird damage per vine

A section of a vineyard comprising 60 vines in which varying degrees of damage occurred was selected. The average percentage of damage on each vine was assessed visually by observing the bunches on each vine and assigning one overall estimation of the damage (a percentage) for each vine. This estimation was recorded as one of the following categories: 0 %; 10 %; 25 %; 50 %; 75 %; 90 % and 100 %. An average percentage of damage per vine was then calculated by averaging the percentages visually recorded for all of the bunches [using method (b)] on each vine. The whole procedure was repeated simultaneously by another worker using a different section of the vineyard which also consisted of 60 vines. The results (Tables 5 and 6) show that there was no significant difference between the two methods and that the visual assessments of damage on whole vines are reasonably accurate.

This method was employed in three separate vineyard blocks, each of 120 vines. Two of these were border blocks in which bird damage was high and one was a centrally situated block in which damage was lower. One of the border blocks and the central block were in a Shiraz vineyard and the other border block was in a Chenin blanc vineyard. In total, 73 min were taken to evaluate the bird damage on the 360 vines concerned. One person was estimating the damage while another was recording the data. The average time spent per vine was 0,20 min. This method of assessing bird damage is 88,02 % quicker than recording the damage per bunch using method (b), and is 98,33 % quicker than the original method of actually counting the damaged berries.

Conclusion

A visual method of evaluating bird damage which is quick yet statistically acceptable has been developed. The quickness of this method enables much larger samples to be taken in order to obtain reliable estimates of bird damage in vineyards. This method will also facilitate obtaining results from control experiments, and will enable such experiments to be more statistically acceptable by allowing more and larger replicates to be used. It must, however, be stressed that the accuracy of the visual methods depends on the experience of the observer. The observer should test himself/herself before relying on the data obtained by the procedure laid out in this report.

TABLE 1 - Comparison of five visual estimations of the percentage of bird damage with the actual percentage of damaged berries using 11 bunches of Chenin blanc grapes

	Treatments					
	Visual assessments					Actual
	Person 1	Person 2	Person 3	Person 4	Person 5	value
No. of observations	11	11	11	11	11	11
Means	65,00	63,64	48,64	53,18	53,18	63,23

D value (P = 0,05) = not significant

TABLE 2 - Comparison of five visual estimations of the percentage of bird damage with the actual percentage of damaged berries using ten bunches of Shiraz grapes

	Treatments					
	Visual assessments					Actual
	Person 1	Person 2	Person 3	Person 4	Person 5	value
No. of observations	10	10	10	10	10	10
Means	29,00	36,00	15,50	23,50	29,00	33,43

D value (P = 0,05) = not significant

TABLE 3 - Comparison of two visual estimations of the percentage of bird damage with the actual percentage of damaged berries using 50 bunches of Chenin blanc and experienced observers

	Treatments		
	Visual assessments		Actual
	Person 1	Person 2	value
No. of observations	50	50	50
Means	30,20	26,50	28,47

D value (P = 0,05) = not significant

TABLE 4 - Comparison of two visual estimations of the percentage of bird damage with the actual percentage of damaged berries using 50 bunches of Shiraz grapes and experienced observers

	Treatments		
	Visual assessments		Actual
	Person 1	Person 2	value
No. of observations	50	50	50
Means	40,60	38,80	42,26

D value (P = 0,05) = not significant

TABLE 5 - Comparison of assessing the mean percentage of damage on 60 Shiraz vines by visually assessing the damage done to each bunch on each vine and visually assessing the mean damage per vine by making one visual estimation of percentage damage per vine

	Treatments	
	Visual assessments per vine	Visual assessments of individual bunches
No. of observations	50	50
Means	73,80	67,41

D value (P = 0,05) = not significant

TABLE 6 - Comparison of assessing the mean percentage of damage on 60 Shiraz vines by visually assessing the damage done to each bunch on each vine and visually assessing the mean damage per vine by making one visual estimation of percentage damage per vine

	Treatments	
	Visual assessments per vine	Visual assessments of individual bunches
No. of observations	50	50
Means	65,60	72,11

D value (P = 0,05) = not significant

WINE GRAPES

PHYSIOLOGY

(S)WI.14/4: THE DETERMINATION OF THE QUALITY OF WINE GRAPES: THE STAGE OF OPTIMUM MATURITY. 1966-1981

C.S. du Plessis

The total soluble solid content (°Balling) of grapes has been applied by wine makers as a parameter of optimum grape maturity for a considerable time. It was accepted that optimum grape maturity was synonymous with optimum grape quality and consequently that of the wine. However, researchers in hot countries were generally of the opinion that °B of grapes was not a truly effective parameter for determining optimum grape maturity. Consequently a study was undertaken to determine the grape

maturity/wine quality relationship and more effective means for determining optimum maturity.

It was found that ripening Chenin blanc, Colombard, Pinotage and Cabernet Sauvignon grapes generally, and in terms of wine quality, increased to maximum quality prior to decreasing thereafter. This decrease in quality could be relatively rapid and for Chenin blanc grapes in the Stellenbosch district a quality drop of up to 15 % could occur within a week of optimum maturity.

The easily determinable components in grapes, *viz* °Balling, total acidity and pH were examined in as many combinations as possible to determine whether an indication of optimum maturity could be obtained from them. Significant correlations were given by *inter alia* °Balling/total acidity (sugar/acid) ratio and the °B x pH product with optimum maturity.

In the Stellenbosch and Robertson areas it was found that optimum maturity of healthy Chenin blanc grapes generally occurred at sugar/acid ratios of between 2,4 and 2,6 for free-run juice. The early occurrence of e.g. rot in grapes of Chenin blanc and other cultivars negated the application of the sugar/acid ratio maturity parameters. In the Robertson area optimum maturity in Colombard grapes occurred at sugar/acid ratios of between 2,2 and 2,4 for free-run juice. In the case of healthy Colombard grapes a 4 h contact of the skins with the juice brought about a significant increase in the bouquet and hedonic acid taste of the wine.

Pinotage grapes from the Stellenbosch area showed optimum maturity at a sugar/acid ratio of approximately 4 whilst Cabernet Sauvignon from the same area did not give a consistent value for optimum maturity. However, a ratio of 3 in addition to a juice pH of 3,55 - 3,60 generally led to good wine quality.

The application of ratios, as those noted above, to define optimum maturity in grapes, was much more effective than a single parameter such as °Balling of juice. It was e.g. found that for a specific vineyard large variations occurred in the °B of the grapes at their optimum maturity over several years. The noted ratios, however, remained remarkably constant under similar conditions.

Although the sugar/acid ratio is not offered as the final solution to the problem of optimum grape maturity, it is a practically applicable and relatively simple tool in the hand of the farmer or wine maker for determining optimum grape maturity.

WINE GRAPES

SOIL SCIENCE

(S)WI.54/1: SOIL PREPARATION STUDIES: EFFECT OF DEPTH OF SOIL PREPARATION AND ORGANIC MATERIAL ADDITIONS ON GROWTH, PRODUCTION AND QUALITY OF WINE GRAPES. 1967-1981

D. Saayman

As a follow-up for similar investigation carried out in the irrigation area of the Breede River valley, the effect of different methods of soil preparation on the performance of Colombar/143B on a Hutton/Clovelly soil was studied at Stellenbosch in the Cape coastal area. Results were generally in accordance with those obtained in the Breede River valley studies and showed no convincing effect of organic material additions, but a strong positive effect of depth and efficiency of soil loosening. Root growth was related to the soil volume loosened and to vine performance. Roots tended to concentrate in the surface soil layers in shallow soil but showed a more desirable uniform distribution in delve ploughed soil. Although costly, delve ploughing the soils used in this study is clearly economically justifiable, primarily because the vineyard reached its potential production level sooner. The effect of eliminating excess acidity during soil preparation was not studied in this project and no optimum soil volume could be determined due to the inability of the implements used to attain sufficient depths. These two aspects are regarded as very important and merit further study.

WINE GRAPES

UP-GRADING

WW.2102/19/2/1: COMPARING THE RESISTANCE OF VINE ROOTSTOCKS TO PHYTOPHTHORA ROOT ROT IN FIELD TRIALS. 1974-1982
P.G. Marais

Grapevine rootstock and *Vitis vinifera* cultivars were screened for resistance to *Phytophthora cinnamomi* in naturally infested field plots. *Vitis vinifera* cultivars were found to be more, or at least as resistant to *P. cinnamomi* infection than the most resistant rootstock. Hybrid cultivars were more susceptible than the pure *V. vinifera* cultivars. The factors responsible for this resistance appear to be able to move through the graft joint, as resistance of most rootstocks improves when grafted with *V. vinifera*. The resistance of *V. vinifera* to *P. cinnamomi* possibly explains the resistance of rootstock cultivars such as Jacquez (*aestivalis* x *V. cinerea* x *V. vinifera*), 143B Mgt (*V. vinifera* x *V. riparia*) and some local crosses having *V. vinifera* in their parentage.

It was also shown that susceptible rootstocks contain higher concentrations of the amino acids glutamic acid, aspartic acid and arginine than the more resistant rootstocks. Results further indicated that these amino acids attracted zoospores of *P. cinnamomi* towards the root surface. A combination of the presence or absence of a number of chemical compounds in the vines could therefore be responsible for some of the differences in susceptibility between different rootstocks.

In a field trial an increase of the soil pH level by applying agricultural lime resulted in less vines dying from *P. cinnamomi* infection. In the field plots statistically more vines died during the second and third year after planting than during subsequent years, indicating that the vines could become more resistant to *P. cinnamomi* infection with age or because older vines can probably generate more new roots than younger vines. This finding together with the fact that liming suppresses *P. cinnamomi* infection, could help in combatting the disease.

WINE GRAPES

WATER REQUIREMENTS

(S)WI.56/1: THE WATER REQUIREMENT OF CHENIN BLANC ON CLOVELLY SOILS IN THE STELLENBOSCH REGION. 1973-1978
J.L. van Zyl

The experiment was conducted in a 12-year-old Chenin blanc vineyard grafted on 99R and trellised on one wire 750 mm above soil level. Vines received no irrigation prior to the commencement of the trial. Irrigation treatments consisted of the application or omission of an irrigation (the soil was initially brought to field capacity by an application of water) in each of the three following growth stages:

(i) Immediately after flowering (middle November)
(ii) During green berry stage (middle December)
(iii) At véraison (beginning to middle of January)

Eight treatment combinations were thus obtained (Table 1).

Irrigations were applied by means of microjets (Series B 280°) delivering 32 ℓ/h at a pressure of 100 kPa which gave an application rate of 6,9 mm/h. The moisture status of the soil was followed mainly with the aid of Bourdon-type tensiometers installed at five depths down to 900 mm. During periods when the soil moisture potential exceeded the measuring range of tensiometers, moisture contents were determined either gravimetrically or with gypsum blocks. Relevant soil and root studies were carried out on the experimental site before the trial started.

Grapevine response was assessed by measuring crop yields, winter pruning mass, shoot elongation and leaf water potential. Total titratable acidity (TTA), sugar content and pH were determined on the must at harvesting while 60 kg of grapes from each treatment were randomly selected for wine making. The experimental wines were evaluated by a tasting panel.

Together with soil moisture measurements, a limited number of meteorological elements *viz* evaporation form the Standard American Weather Bureau Class A pan, rainfall, relative humidity and air

temperature were measured on the experimental site. Additionally, data from weather stations 8 km from the experimental vineyard were also available.

Soil Moisture Extraction

Soil moisture measurements showed a depletion of all available soil moisture in the entire root zone of the dryland control in January (Fig. 1). Much more favourable moisture regimes were created in the irrigated plots as illustrated in Fig. 2. The moisture status of the soil was reflected in the behaviour of the vines as could be observed in the field. Leaves from the control plots did not wilt, but yellowing and shedding of the leaves showed the location of unirrigated as well as other dry plots clearly. Grapes from the dryland plots suffered more from sunburn than those from irrigated vines. Despite these drought symptoms and the fact that, in every season, grapes were not harvested before March, the dryland vines still produced well, and grapes had a high sugar content.

Leaf water potential (Table 2) was unexpectedly high for the dryland vines. Although water potential for the irrigated BBB vines (Table 1) was higher compared to that of the control vines, the differences were smaller than would have been deduced from a comparison between total available moisture contents in the soil. The vines were thus able to recuperate from moisture stress during the night, but the source of this moisture is still unknown. The possibility of several deep roots which are able to explore deeper, wetter soil layers is highly unlikely of the shallow root systems involved (Fig. 3) which is the result of unfavourable chemical and physical soil conditions in the subsoil.

Examination of soil water extraction patterns with depth after irrigation revealed a shift in the pattern of water depletion. During November moisture extraction followed the expected pattern *viz* a rapid rate of depletion near the soil surface, which decreases with depth. During January a total reversal took place. The soil moisture potential of the subsoil decreased at a faster rate than that of the surface layers. This total change in moisture depletion pattern from November to January had been measured on all experimental plots and in both seasons. This finding calls for more research on the deeper part of the soil, apparently not penetrated by roots, but nevertheless a possible reservoir for water.

TABLE 1 - Eight irrigation treatments tested in a field trial on Chenin blanc near Stellenbosch

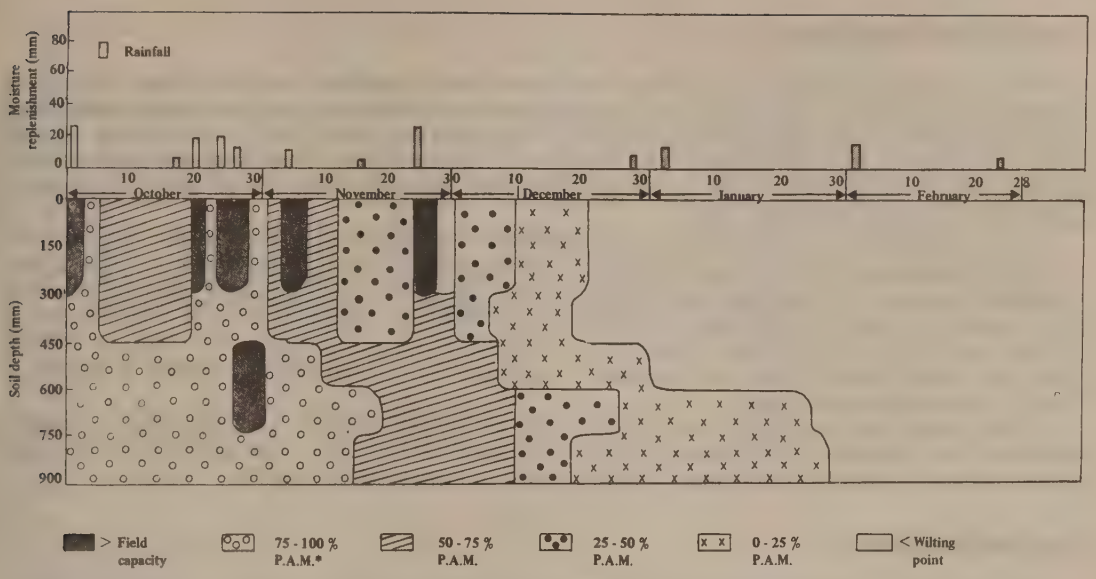
Growth stages in which irrigations were applied			Treatment
Fruit set	Green berry	Véraison	code
B	B	B	BBB
B	O	B	BOB
B	B	O	BBO
B	O	O	BOO
O	O	O	OOO
O	O	B	OOB
O	B	O	OBO
O	B	B	OBB

B - Irrigated
O - Non-irrigated

TABLE 2 - Leaf water potentials determined on vines of two irrigation treatments at 05 h 00

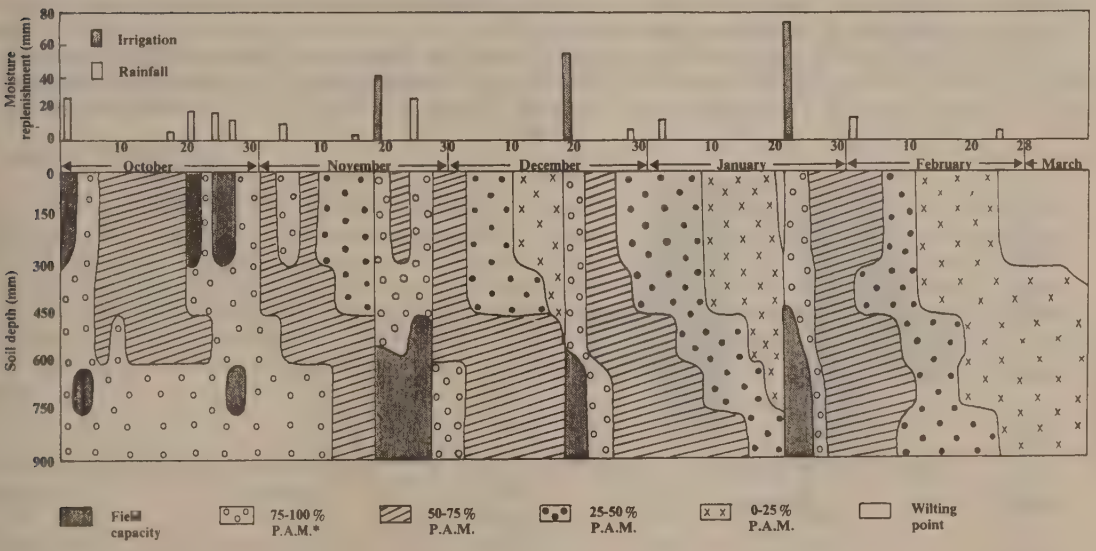
	Leaf water potential (kPa)			Total available moisture (mm)		
Date	OOO (1)	BBB (2)	Difference (1) - (2)	OOO (3)	BBB (4)	Difference (4) - (3)
22/11/74	-118	- 39	- 79	44,62	80,98	36,36
27/12/74	-141	- 83	- 58	0,81	52,01	51,20
31/12/74	-171	-100	- 71	- 2,21*	46,67	48,88
7/01/75	-215	-100	-115	- 3,57*	40,08	43,65
10/01/75	-160	- 89	- 71	- 4,40*	27,03	31,43
14/01/75	-184	-113	- 71	- 5,70*	21,48	27,18
17/01/75	-283	-168	-115	- 6,34*	17,71	24,05

*Moisture content below field capacity



* P.A.M. Plant-available moisture

FIG. 1 - Soil water content with depth in the non-irrigated treatment during the 1974/75 season



* P.A.M. Plant-available moisture

FIG. 2 - Soil water content with depth in the BBB treatment during the 1974/75 season

Grape Yield and Shoot Growth

Yields varied greatly among the eight treatments with significant and even highly significant differences between them. The highest yield was obtained from the three irrigation treatments (BBB) while the control (OOO) always produced the lowest. Fig. 4 indicates that grape yield did not increase linearly with an increasing number of irrigations. One irrigation (at the correct time) had the largest positive effect, but the response became less as the number of irrigations increased from one to three, suggesting a limiting factor to yield other than water.

A water application just after flowering was beneficial to both yield and shoot growth. The fact that the soil still contained 50-60 % available water at that stage in all seasons, shows that the vine is very susceptible to even a low moisture stress during the fruit set period. No significant effect of irrigation during green berry stage on yield and shoot growth could be found despite the low soil moisture content at that time (<40 % total available moisture). An irrigation at véraison produced no effect on pruning mass, but resulted in the largest yield increase. Considering the low soil moisture content at that stage (Fig. 1), this result is not surprising.

These results thus stress the necessity to apply the limited quantity of water which is usually available in the traditional dryland regions at the correct growth stages of the vine, namely at fruit set and véraison with preference to the last stage if water for only one irrigation is available.

Grape and Wine Quality

No significant differences were found in sugar content among treatments and all treatments reached a sugar content of 20 °B simultaneously. Should sugar content be used as a criterion for time of harvesting, no differences did exist among treatments as regards ripening date. It should, however, be kept in mind that only limited irrigation was applied and that the last irrigation was applied at least five weeks before harvesting.

Irrigation increased the acidity (T.T.A.) of the grapes at harvesting time. It was especially the early irrigations (at fruit set and at green berry stage) which also had a positive effect on vegetative growth, that resulted in a higher T.T.A. The increase in T.T.A. is most probably directly associated with an improved leaf surface which in turn, may lower fruit temperature and light exposure. Despite these effects on T.T.A. no significant effect on pH of the must was found.

Significant differences did occur in each season among the organoleptic quality of the experimental wines, but none of the treatments resulted in constantly better or poorer wines. The dryland control plots did not produce wines of exceptional quality. In both seasons more than half of the wines originating

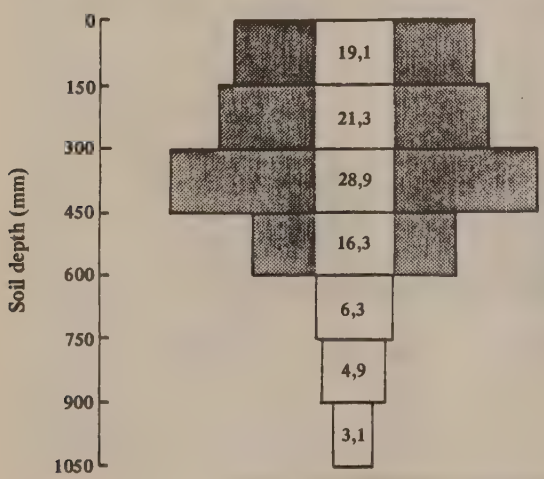


FIG. 3 - Schematic presentation of percentage roots (averages of 6 plots) found at different depths in the experimental vineyard

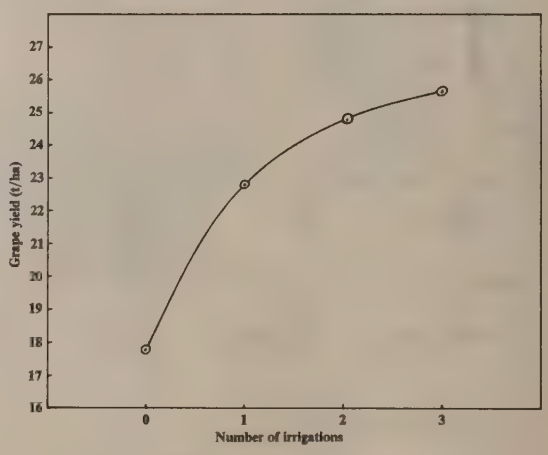


FIG. 4 - Grape yield increase of Chenin blanc with increasing number of irrigations

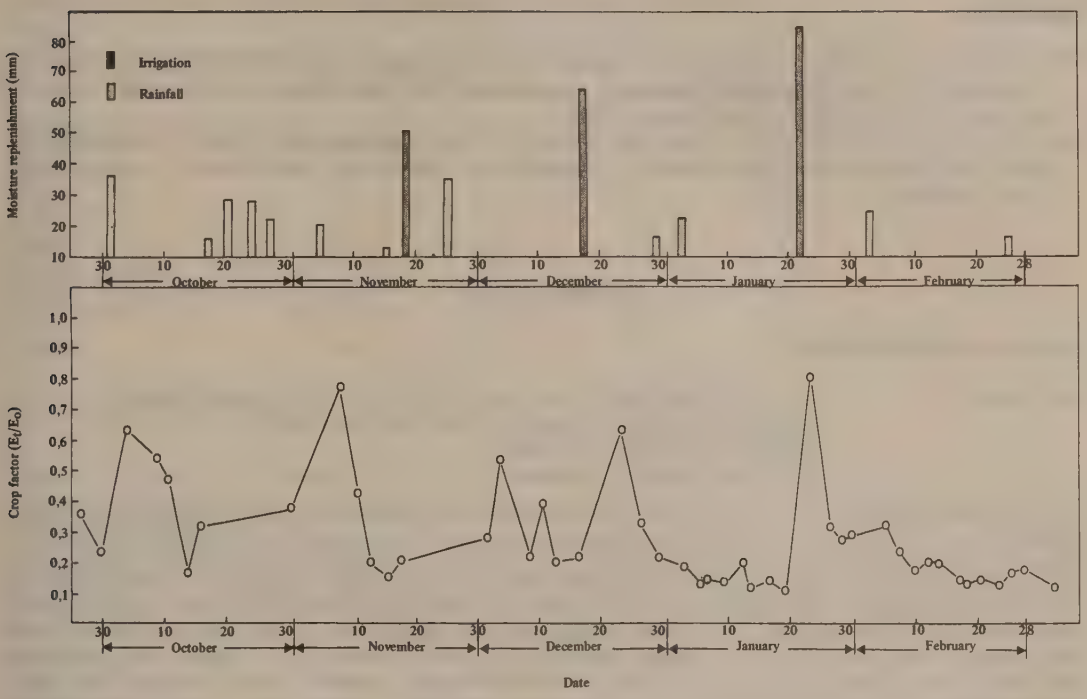


FIG. 5 - Variation in crop factor values for wine grapes during the 1974/75 season (OBB treatment)

from irrigated plots, including BBB, scored higher (though not always significantly) than the control. It can therefore be concluded that judiciously applied, supplementary irrigation as was the case in this experiment, is at least not detrimental to wine quality.

Irrigation Requirement

The quantity of water applied differed from year to year. The three treatments which are recommended, received the following net quantities of water: OOB = 90 mm; BOB = 133 mm and BBB = 175 mm. Class A pan evaporation data were used to calculate crop factors for the different growth stages of the vines (Table 3). These factors are low and only applicable to a practice of limited irrigation in the Coastal Region since crop factor values are highly dependent upon the soil moisture content as can be seen from Fig. 5. Immediately after a rainfall or an irrigation very high crop factors were obtained. At the next set of moisture determinations (two or three days later) the crop factors were already much lower.

TABLE 3 - Crop factors for wine grapes trellised on one wire in the Stellenbosch area during different growth stages

Date	Growth stages	Treatment			Average
		BOB	OBB	BBB	
27 09 - 18 11	Bud burst - flowering	0,34	0,36	0,38	0,36
18 11 - 18 12	Flowering - green berry	0,31	0,24	0,27	0,27
18 12 - 21 01	Green berry - véraison	-	0,24	0,19	0,22
21 01 - 5 03	Véraison - harvest	0,29	0,26	0,19	0,25

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WINE GRAPES

WATER REQUIREMENTS

(S)WI.56/6: A COMPARATIVE EVALUATION OF TRICKLE AND FLOOD IRRIGATION ON VARIOUS SCION/ROOTSTOCK COMBINATIONS. 1978-1980

J.L. van Zyl and J.S. Marais

The object of this study was to compare trickle and flood irrigation with regard to grape yield, shoot growth, wine quality and irrigation water requirement on the fertile alluvial soil (Dundee form) of the Olifants River valley. The experimental vineyard was irrigated by these two systems since planting, but measurements only commenced when the grapevines were in full bearing. A spacing of 1 m was used for 4 ℓ/h tricklers. Irrigation scheduling was at first carried out with the aid of Class A pan evaporation data, but this method was discarded in favour of tensiometers, installed at 20, 40, 60 and 90 cm depths. Although the vineyard was trickled two times weekly at the onset of the trial, the irrigation frequency was increased to three applications per week from the 1978/79 season onwards. Flood irrigation took place when readings of both shallowest tensiometers (installed in the zone of highest root concentration) reached 40 kPa. Ample water to wet the soil profile to a depth of 1,0 m was then applied (water holding capacity of the soil = 166 mm/m).

No statistically significant differences were found between flood and trickle as regards both grape yield and shoot growth (Table 1). Organoleptic evaluation of experimental wines also showed a good similarity between flood and trickle irrigation in this respect. Small differences were not significant (Table 2).

During both seasons seven flood applications (gross quantity of 700 mm per season) were given between budding and harvesting. Tensiometer readings indicated an irrigation cycle of 16 days during the period of peak water consumption (January). The total water application with tricklers was 714 mm and 735 mm for the 1978/79 and 1979/80 seasons, respectively. These quantities are practically the same as those applied with flood irrigation. Despite this relatively high water application with trickle irrigation, the subsoil dried out slowly during the ripening period. The water replenishment was obviously still too low to balance the consumptive use. The failure to save water with trickle irrigation in this experiment is due to the very slow water infiltration rate on these soils which contain a high percentage of fine sand (10 % clay; 6 % silt; 66 % fine sand; 15 % medium sand; 3 % coarse sand) and tend to compact under irrigation and clear cultivation. Under the tricklers water collected into small pools on the soil surface; a phenomenon which results in heavy water losses through evaporation. This unfavourable situation became more acute towards the end of the season as manifested in the drying out of the subsoil. Slow water infiltration did not pose a problem with flood irrigation to the same extent, probably due to cracks which form in the

TABLE 1 - Average grape and shoot mass obtained with two methods of irrigation during the 1978/79 and 1979/80 seasons

Measurement*	1978/79		Statistical differences	1979/80		Statistical differences
	Flood	Trickle		Flood	Trickle	
Grape yield (t/ha @ 20 °B)	24,32	23,44	N.S.	29,48	29,73	N.S.
Shoot mass (t/ha)	2,35	2,43	N.S.	3,97	4,17	N.S.

*Average of 24 cultivars, each replicated twice on four rootstocks
N.S. - Not significant

TABLE 2 - Organoleptic wine quality of grapes grown under two different irrigation methods

Cultivar	Evaluation figure (%)			
	1978/79		1979/80	
	Flood	Trickle	Flood	Trickle
Colomino	-	63,5	43,6	42,9
Palomino	38,2	-	46,4	41,4
Chenin blanc	56,5	62,9	51,4	45,0
Chenel	46,7	-	48,6	47,9
Raisin blanc	-	-	45,7	51,4
Colombar	-	-	40,0	42,1
Weldra	50,6	48,2	-	-
Muscat d' Alexandrie	70,0	67,6	-	-
Pinotage	64,4	60,0	45,7	42,5
Tinta Baroccas	56,1	60,0	27,4	28,9
Cinsaut	-	-	22,8	21,4
Cabernet S.	70,6	68,8	50,7	56,4
	LSD = 8,0		LSD = 8,0	

LSD - Least significant difference

drying soil and act as channels for water penetration. Only limited success with regard to water penetration was obtained by the application of gypsum (10 t/ha) or through the sowing of a winter cover crop, Wimmera rye grass.

Results obtained in this experiment yielded no justification as far as growth, production and quality are concerned, to install expensive trickle irrigation systems on the dark alluvial Dundee soils of the Olifants River area, which is well suited for flood irrigation. However, the actual problem on these soils is water infiltration and practical methods to improve water penetration will be studied under cover of a new project.

DRIED GRAPES

PATHOLOGY

(S)WI.35/1(K) & 35/2(K): INVESTIGATIONS INTO THE CAUSE AND CONTROL OF GROWTH ARRESTMENT DISEASE OF SULTANA. THE EFFECT OF POTASSIUM APPLICATIONS, IRRIGATION AND PRODUCTION LEVEL ON THE INCIDENCE OF GROWTH ARRESTMENT DISEASE. 1973-1981

D. Saayman

Growth abnormalities that were christened "growth arrestment disease" (GAD) that occur in the predominantly sultana vineyards of the Lower Orange River region, causing estimated crop losses of more than 60 % in certain seasons, were first described in 1955. It was characterised by poor budding, retarded shoot growth during flowering, localised blackening of peduncles, abortion of flower clusters followed by renewed vigorous shoot growth and flower shatter. Single vines or patches of vines were affected and climate obviously enhanced or suppressed the occurrence of GAD, making it difficult to identify potential GAD vines or vineyards.

Various factors which may be involved in causing GAD were evaluated by means of a survey and extensive soil and plant analyses. Low K concentrations in both soil and plant organs as well as insufficient irrigation, especially during dormancy were found to have a bearing on GAD, but in experiments conducted to verify the effect of K nutrition and controlled irrigation, only the latter factor showed promising results. Analyses of various organs of GAD afflicted and normal vines showed GAD vines to be lacking in starch reserves and to contain high concentrations of N, Mn and Zn which were invariably associated with low K concentrations especially in affected tissue which also contained unexplicably high concentrations of Fe and Cu.

It was concluded that excessive vigour and an abnormally continuing vigorous growth after harvest due to hot climatic and fertile soil conditions were amongst the major factors causing GAD, because it resulted in poor carbohydrate reserves accumulation and excessive N uptake. Climate clearly affects the severity of GAD but the mechanism of this effect as well as that of inadequate irrigation and an excess of N, is still unclear. The low K values encountered in GAD vines, were considered to be the result of GAD

rather than the cause. The need for further studies concerning the specific action of a high level of N nutrition, the effect of temperature and practical means of controlling vigorous and prolonged growth, was indicated.

Oenology

WINE

MICROBIOLOGY

(S)WI.24/2: CLASSIFICATION OF WHITE CULTIVAR WINES BY ORIGIN USING VOLATILE AROMA COMPONENTS. 1973-1981

J. Marais, P.C. van Rooyen and C.S. du Plessis

The aim of this study was to select key components, mainly fermentation-produced flavour compounds, which relate to the geographic origins of the wines as well as to direct further investigations into selection and identification of wine quality parameters in order to relate chemical composition of wine to sensory quality. The study was performed on two commonly cultivated white wine cultivars in South Africa, *viz* Chenin blanc and Colombar.

The components analysed as well as their average concentrations for the Colombar and Chenin blanc wines are given in Table 1.

TABLE 1 - Average concentrations of esters, higher alcohols and acids of Colombar and Chenin blanc wines from different regions (1979 vintage)

	Colombar		Chenin blanc		
Components (mg/l)	**Robertson**	**Lutzville**	**Stellenbosch**	**Robertson**	**Lutzville**
Esters					
Ethyl acetate	39,26	44,55	46,02	44,23	48,30
Ethyl butyrate	0,40	0,54	0,61	0,52	0,55
i-amyl acetate	2,90	4,37	2,67	2,39	2,52
Ethyl caproate	0,75	0,92	0,84	0,84	0,83
Hexyl acetate	0,16	0,19	0,13	0,09	0,14
Ethyl caprylate	1,35	1,53	1,41	1,50	1,55
Ethyl caprate	0,39	0,40	0,27	0,32	0,29
2-phenethyl acetate	0,15	0,18	0,13	0,15	0,14
Higher alcohols					
i-butanol	24,28	26,02	26,20	26,94	28,42
Amyl alcohols	169,71	157,71	139,86	162,46	147,95
Hexanol	1,07	1,08	1,04	1,36	0,93
2-phenyl ethanol	20,31	15,39	11,45	17,31	15,75
Acids					
Hexanoic acid	5,49	7,22	6,13	5,86	5,88
Octanoic acid	6,88	8,01	7,72	7,23	7,14

The components (variables) were classed into three sets, *viz* (1) four higher alcohols, (2) eight esters and (3) the total of the first two sets plus two acids. Data processing was executed on a Burroughs 7 700 computer, discriminating amongst wines of the same cultivar originating from the different wine regions.

Colombar

A stepwise multiple discriminant analysis (SDA) was applied to data from wines from two regions, *viz* 10 and 12 wines from the Robertson and Lutzville areas, respectively. The most successful separations were obtained employing the variables in Sets 2 and 3. The discriminant variables in decreasing order of importance for each set as selected by SDA are given in Table 2.

In both cases it was found that i-amyl acetate was the most effective discriminant. Although a classification was relatively unsuccessful employing Set 1 (higher alcohols) [Fig. 1(a)], i-butanol emerged as the second most important discriminant when Set 3 [Fig. 1(c)] was implemented. Canonical plots of the separations of the wines from two regions employing Sets 1, 2 and 3 are shown in Fig. 1.

TABLE 2 - Significance of discriminant variables for the classification of 22 Colombar wines into two regions employing Set 2 (esters) and Set 3 (esters + higher alcohols + acids)

Set 2		Set 3	
Variable entered	**F value to enter**	**Variable entered**	**F value to enter**
i-amyl acetate	20,14**	i-amyl acetate	20,14**
Hexyl acetate	10,93**	i-butanol	13,11**
Ethyl caprylate	5,96**	2-phenethyl acetate	7,90**
Ethyl butyrate	2,21 ns	Hexanoic acid	7,27**
2-phenethyl acetate	1,80 ns	Hexanol	6,49**
Ethyl caprate	0,93 ns	Hexyl acetate	6,13*
Ethyl caproate	0,22 ns	Ethyl caprylate	5,02*
Ethyl acetate	0,01 ns	Octanoic acid	3,92*
		Ethyl caproate	2,77 ns
		Ethyl butyrate	2,67 ns
		2-phenyl ethanol	2,05 ns
		Ethyl acetate	1,92 ns
		Ethyl caprate	1,83 ns
		Amyl alcohols	0,38 ns

** = Highly significant at $P < 0,01$
* = Significant at $P < 0,05$
ns = Not significant

From both Fig. 1(b) and (c) it can be seen that i-amyl acetate was by far the most powerful discriminant between regions while the other variables were not able to separate the groups on their respective axes. It is noteworthy that i-amyl acetate also emerged as the most effective component in the differentiation between the wines of Pinotage and Cabernet Sauvignon cultivars in a previous study (Marais, Van Rooyen & Du Plessis, 1981). It is reasonable to conclude that this compound is a relatively sensitive parameter, at least for the conditions in these experiments. The findings of Houtman & Du Plessis (1981) similarly noted the importance of acetate esters as sensitive indicators with respect to fermentation conditions. Ester formation is dependent upon *inter alia* a supply of alcohols and acids and the formation of acyl-CoA-compounds (Nordström, 1964; 1966). All the acetate esters and their corresponding higher alcohols, except hexyl acetate, are produced during amino acid metabolism by the Ehrlich mechanism as well as during amino acid synthesis by enzymatic reactions during the course of fermentation. The alcohol moiety of i-amyl acetate derives from the de-amination of leucine which, depending upon its availability, could lead to differences in the concentration of this ester in wines. However, the formation of esters and specifically i-amyl acetate is an extremely complex process and is also affected by factors other than specific amino acid concentrations. It is consequently difficult at this stage to ascribe the significant variations in i-amyl acetate concentrations between Colombar wines of different regions to one specific factor and this aspect certainly requires further study. Hexyl acetate formation is more dependent on the six-carbon precursors present in the juice (Drawert & Rapp, 1966).

It has been reported that variations in specific ester concentrations within a series of wines of a cultivar are often as great as amongst different cultivar wines (Houtman, Marais & Du Plessis, 1980;

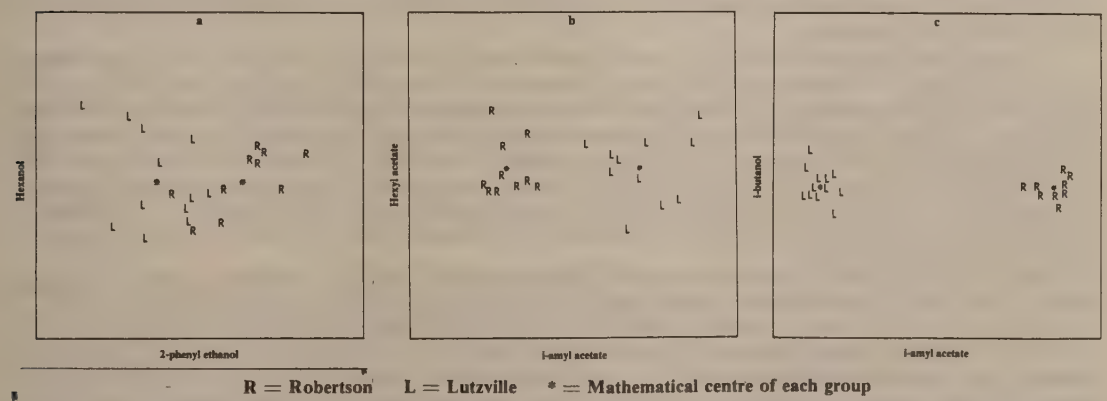

FIG. 1 - A canonical plot showing separation of Colombar wines from Robertson and Lutzville areas on the basis of (a) four higher alcohols, (b) eight esters and (c) four higher alcohols, eight esters and two acids (1979 vintage)

Noble, Flath & Forrey, 1980). Furthermore, it has been shown that different fermentation temperatures of the same must could produce variations in ester concentrations (Kilian & Ough, 1979).

Fermentation conditions for all the wines were identical in this study, but it is important to note that in the case of esters which are sensitive to cellar manipulations, results from discriminant analysis should be employed with caution.

Chenin blanc

By employing the same three sets of variables as in the case of the Colombar wines, the most successful separations of Chenin blanc wines from Stellenbosch (16 wines), Robertson (12 wines) and Lutzville (10 wines) regions were obtained with Sets 1 and 3. In both cases hexanol and 2-phenyl ethanol were selected as the most important discriminants. The discriminant variables in decreasing order of importance for each set are given in Table 3.

TABLE 3 - Significance of discriminant variables for the classification of 38 Chenin blanc wines into three regions employing Set 1 (higher alcohols) and Set 3 (esters + higher alcohols + acids)

Set 1		Set 3	
Variable entered	**F value to enter**	**Variable entered**	**F value to enter**
Hexanol	24,11**	Hexanol	24,11**
2-phenyl ethanol	19,04**	2-phenyl ethanol	19,04**
Amyl alcohols	14,40**	Ethyl caproate	18,64**
i-butanol	10,64**	2-phenethyl acetate	14,84**
		Amyl alcohols	14,40**
		i-butanol	10,64**
		Hexyl acetate	6,35**
		Octanoic acid	6,19**
		Ethyl butyrate	4,75**
		Ethyl acetate	4,38**
		Ethyl caprylate	3,55**
		i-amyl acetate	1,75 ns
		Ethyl caprate	0,82 ns
		Hexanoic acid	0,32 ns

** = Highly significant at $P \leqslant 0,01$
ns = Not significant

Employing only the esters in Set 2, successful classifications could not be obtained. Canonical plots of the classifications employing Sets 1, 2 and 3 are presented in Fig. 2.

From Fig. 2(a) and (c) it can be seen that as a discriminant hexanol was reasonably successful in discriminating among the wines from the three regions [Fig. 2(c)], but that 2-phenyl ethanol had no utility as discriminant between the Chenin blanc wines from the Robertson and Stellenbosch areas. The less obvious discriminatory power of the same variables when employed in Set 1 [Fig. 2(a)] illustrates the importance of the additional variables in the case of Set 3, contributing significantly to the reduction of uncertainty in the separations.

Hexanol derives from linoleic and linolenic acids which are likely constituents of the waxy bloom covering the skin of the grape berry (Brander, Kepner & Webb, 1980). Skin/juice contact as well as differences in the concentrations of these acids amongst cultivars or with a specific cultivar from different localities could produce differences in the concentrations of hexanol in the wines. In this study both Chenin blanc and Colombar grapes received the same free-run treatment. 2-phenyl ethanol which was also the second most important component in the differentiation amongst Chenin blanc wines of the three regions (Table 3), derives via the Ehrlich mechanism from the amino acid phenyl alanine. As in the case of the Colombar wines a study of the amino acids should be incorporated to determine whether they can be related to regional differences.

With reference to the contribution of the selected compounds to the flavour of wine, odour threshold values could possibly provide some useful information. Odour threshold values (ppm) as determined in a specially prepared wine residue medium by De Wet, Augustyn, Van Wyk & Joubert (1978) revealed values of 0,16 and 0,64 for i-amyl acetate and optically active amyl acetate, respectively. The two components were not gas chromatographically separated and were analysed as one component, *viz* i-amyl acetate, which normally amounts to approximately 90 % of the total amount amyl acetates. Compared to i-amyl acetate concentrations in Table 1 it seems reasonable to assume that this fermentation-produced

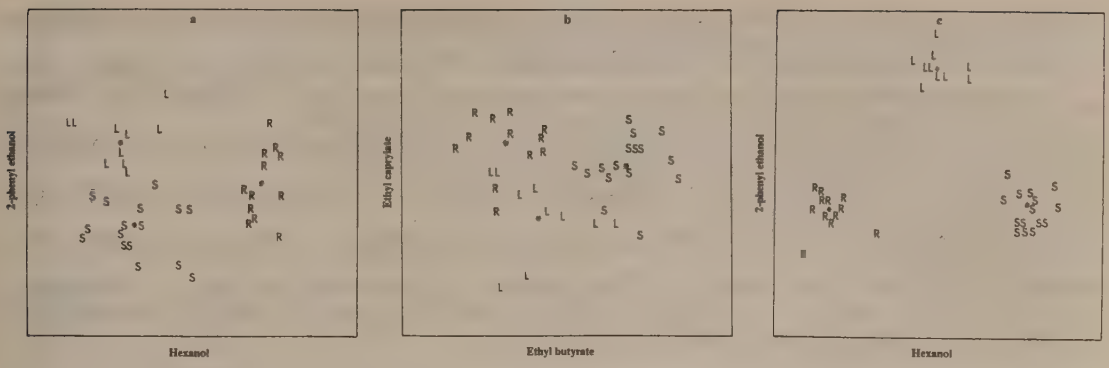

FIG. 2 - A canonical plot showing separation of Chenin blanc wines from Stellenbosch, Robertson and Lutzville areas on the basis of (a) four higher alcohols, (b) eight esters and (c) four higher alcohols, eight esters and two acids (1979 vintage)

compound makes a significant contribution to wine quality, especially to the young wine bouquet. This corresponds with research reported on this aspect of wine quality by Marais & Pool (1980) where highly significant correlations were found between i-amyl acetate concentrations and young wine bouquet. Other available odour threshold values are 0,67 (hexyl acetate), 227,90 (i-butanol) and 1,08 (hexanol). It is clear that i-butanol concentrations (Table 1) are much too low to make a significant contribution to wine flavour.

It is important to note that the regional classifications were achieved by utilising wines from grapes at different stages of maturity. It therefore appears that the effect of this factor is relatively insignificant in relation to that of the region. Similarly Rapp, Hastrich, Engel & Knipser (1978) found that differentiation of Riesling and Morio Muscat grapes was possible and independent of stage of ripeness. The three regions involved in this study have fairly different climatic conditions, *viz* the relatively cool Stellenbosch area where viticulture can be practised without irrigation, the relatively dry hot Robertson area and the desert-like conditions in the Lutzville area.

Highly successful regional classifications of wines made from the white wine cultivars Colombar and Chenin blanc were obtained by application of SDA. These classifications could be executed by the utilisation of relatively few fermentation-produced flavour compounds.

The value of multivariate analyses is far-reaching in that, apart from its use in geographical classification or cultivar identification, it also opens promising fields of investigation pertaining to wine quality and character parameters. More should be learned of the contributions of aspects such as cultivar, regional and climatic conditions as well as viticultural and cellar technological practices which are normally reflected in the chemical compositions of the wines. The coupling of discriminatory components such as i-amyl acetate in the case of Colombar and hexanol in the case of Chenin blanc wines as well as their formation mechanisms, to wine quality, is a distinct possibility.

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WINE

MICROBIOLOGY

(S)WI.24/3: AROMA AND RELATED COMPONENTS OF BRANDY, WINE AND GRAPES: THE PRECURSORS IN GRAPES OF THE ETHYL OCTANOATE AND ETHYL DECANOATE ESTERS IN WINES.
1973-1977
A.C. Houtman

It was determined that highly significant correlations existed between the two esters, *viz* ethyl octanoate (C8E) and ethyl decanoate (C10E) and wine quality. This finding was most promising with reference to the objective determination of wine quality but furthermore provided a good point of departure for an investigation of those components in grape juice which are the precursors of the above indicators of wine quality. The subsequent study investigated *inter alia* means of promoting their formation during fermentation and the effect of the esters and their fatty acid moieties on wine quality.

It was found that additions of phosphate, nitrogen, nutrilites as well as 12 amino acids to the juice had no influence on the formation of C8E and C10E, i.e. relative to the same juice to which no additions had been made. Apparently musts generally contain sufficient of these components. With respect to ethanol, which supplies the ethyl moiety of the ester, an addition to the juice prior to fermentation similarly had little effect on the promotion of ester formation in the wine. To determine whether grape maturity, especially with reference to increasing sugar concentrations, influenced the C8E and C10E concentrations, glucose additions were made to juice from immature and mature grapes. The resultant wines showed that ester concentration reacted positively to sugar increments whether by addition or natural increase in the grape by ripening. Sugar, i.e. glucose or fructose, could on both practical and theoretical grounds, be regarded as a precursor of C8E or C10E esters.

It was found that C8E and C10E esters in themselves did not appear to contribute to wine quality since increasing their concentration in wines did not bring about increased wine quality. The addition of the acid moiety of the ester to juice in various concentrations only caused an increase in the ester concentration in the wine when excessive concentrations of acids (~20 mg/ℓ) were added. Under these conditions wine quality was not increased.

WINE

MICROBIOLOGY

(S)WI.30/1: THE MATURATION OF WINE: THE INFLUENCE OF TIME, TEMPERATURE AND pH ON SPECIFIC WINE COMPONENTS AND WINE QUALITY. 1977-1981
J. Marais

Ageing can bring about marked changes in the character of a wine and quality may either increase

or decrease. Components which are important in this respect are the esters, higher alcohols and also dimethyl sulphide with respect to the bottle bouquet. These components can be influenced by temperature, pH and time. In this study these factors were studied with respect to the latter components and their effect on wine quality determined.

Dry white wines of the cultivars Chenin blanc, Riesling and Colombar were held at 0 °, 10 °, 20 ° and 30 °C for 12 months. The wines were periodically analysed for esters, higher alcohols and dimethyl sulphide and sensorily evaluated for young wine bouquet, maturation bouquet and total wine quality. Increases in storage time and temperature caused marked decreases in the concentrations of i-amyl acetate, hexyl acetate, 2-phenethyl acetate, ethyl butyrate, ethyl caproate, ethyl caprylate, ethyl caprate, total esters and young wine bouquet and marked increases in the concentrations of dimethyl sulphide, di-ethyl succinate and maturation bouquet. Highly significant relationships were found between chemical components and sensory evaluations of the wines. A highly significant correlation was found between dimethyl sulphide and the bottle maturation bouquet, confirming the important contribution of this component to wine quality. Furthermore, a significant relationship was found between ethyl acetate concentration and varietal bouquet. It was also determined that the rate of dimethyl sulphide formation in white wines differed between cultivars.

In Colombar wines it was determined that at low pH values acetate ester concentrations decreased more markedly than those of ethyl esters. In contrast, di-ethyl succinate concentrations increased at low pH.

It was found that the effect of time and temperature on ageing of white wines can be utilised by either preserving the young wine bouquet for an extended period of time or to produce a well-aged wine within a relatively short period.

WINE

MICROBIOLOGY

(S)WI.36/2: INVESTIGATION INTO METHODS FOR DECREASING SULPHUR DIOXIDE IN WINES: EFFECT OF DISSOLVED OXYGEN AND SOME ANTIOXIDATIVE GASES ON THE SO_2 REQUIREMENT OF WINES. 1979-1981

T.J. van Rooyen

The rate and consequences of combination of oxygen in musts and wines were studied. It was found that an untreated must combined 8 mg O_2/ℓ in as little as 20 min whereas a pasteurised must retained approximately 8 mg O_2/ℓ for more than 4 h. The combination of oxygen in wine caused a decrease in alcohol content, an increase in acetaldehyde concentration and a considerable decrease in the free sulphur dioxide content. These results accentuated the use of antioxidative gases in wine-making to inhibit the uptake of oxygen during wine-making and storage. It was found that blanketing with inert gases during wine-making led to a decrease in the SO_2 requirement of wines, the prevention of aerobic organism development and the improvement of wine quality. Of the different gases and combinations of gases that were tested, it was found that pure CO_2 was very effective, especially for wines lacking in acidity and with a low CO_2 content. For wines with too high CO_2 contents, a nitrogen-argon mixture was found to be most effective, as they tend to lower the amount of CO_2 in wines for which a decrease is desirable. Mixtures of nitrogen and argon were found to have a stabilising effect on the CO_2 content of a wine and are most suited for long-term storage.

WINE

MICROBIOLOGY

(S)WI.69/2: INVESTIGATION INTO THE PROBLEM OF MALO-LACTIC FERMENTATION IN SOUTH AFRICAN WINES: IDENTIFICATION AND EVALUATION OF MALO-LACTIC BACTERIA IN SOUTH AFRICAN WINES. 1978-1981.

L.M. van der Westhuizen

Malo-lactic bacteria were isolated from Cabernet Sauvignon type dry red wines from 10 Western Cape wineries by means of three different procedures. The method of streaking a loopful of wine on modified Rogosa agar plates which are incubated in an atmosphere with a raised CO_2 level gave the most representative picture of the malo-lactic flora in the wines.

Of the 137 malo-lactic bacteria isolated, 84 were lactobacilli, 37 leuconostocs and 16 pediococci. Fifty-four of the 84 lactobacilli were homofermentative and 30 heterofermentative according to gas production in initial tests in modified Rogosa medium; 52 of the former and 27 of the latter were further characterised for identification according to the key in the eighth edition of Bergey's Manual of Determinative Bacteriology and the API 50 *Lactobacillus* system. The homofermentative lactobacilli comprised 36 isolates of *Lactobacillus plantarum,* and 15 unidentified isolates with possible affinities to *Lactobacillus casei* or *L. plantarum.* Of the heterofermentative lactobacilli, one was designated 'atypical *Lactobacillus brevis',* 20 could not be identified and six were ultimately designated homo- or heterofermentative *Lactobacillus* spp. because gas production from glucose was not confirmed in modified MRS medium and the API 50 *Lactobacillus* sugar fermentation tests. The 20 unidentified heterofermentative lactobacilli were unique in their ability to ferment cellobiose, melezitose and melibiose and resembled an unidentified strain which was previously isolated from South African wines.

Twenty-eight of the leuconostocs were characterised further. Eight of them agreed with the descriptions of *Leuconostoc oenos* in the eighth edition of Bergey's Manual of Determinative Bacteriology. The others differed from these descriptions in respect of only one or two characteristics and were regarded as atypical strains of *L. oenos.*

The 14 *Pediococcus* isolates which were characterised further, all appeared to be *Pediococcus pentosaceus* according to the eighth edition of Bergey's Manual of Determinative Bacteriology.

Of the 30 isolates chosen as representatives of all the malo-lactic isolates two *L. oenos* strains completed the malo-lactic fermentation in significantly shorter times than the other isolates under most of the different experimental conditions of temperature (15 and 20 °C), pH (3,5 and 3,8) and SO_2 concentration (34 and 61 mg/ℓ). The higher temperature and lower SO_2 concentration were significantly more favourable for the induction of malo-lactic fermentation than the lower temperature and higher SO_2 concentration, but the two pH levels caused no significant differences in fermentation rate. The most important factor which significantly decreased the colour of the wine during the malo-lactic fermentation was SO_2, particularly at the higher concentration, while the bacteria did not differ significantly in respect of the amount of colour loss that they caused.

Five bacterial cultures were tested further for their MLF ability during two consecutive harvesting seasons. The bacteria tested were *L. oenos* strain Ca3 of the OVRI, *L. oenos* strain Ia8 of the OVRI, *L. oenos* ML34 from California, a homofermentative *Lactobacillus* sp., isolate Gb1 of the OVRI, resembling *L. casei,* and Equilait, a French commercial strain of a *Lactobacillus* sp.

During the first season Pinotage grapes were harvested at 24,8 °B, and 3 g tartaric acid/ℓ was added to obtain a total acid concentration of 7,4 g/ℓ and a pH of 3,5. SO_2 was added to a concentration of 47 mg free SO_2/ℓ and 74 mg total SO_2/ℓ. *Leuconostoc oenos* strain Ia8 completed MLF within 18 days after inoculation into the wine. One replication each of *L. oenos* ML34, *L. oenos* strain Ca3 and *Lactobacillus* isolate Gb1 only completed the fermentation within 57 days. The other replications completed the fermentation within 67 to 77 days which was just as long as the controls took to complete MLF. It is highly probable that contamination of the latter replications took place. The wines all had a final alcohol concentration of between 14,39 and 15,69 % by volume. This could have delayed the growth and MLF of the bacteria except in the case of *L. oenos* strain Ia8 which seems to be more tolerant towards high alcohol concentrations.

During the second season Pinotage grapes were harvested at approximately 24 °B with a total acid concentration of 7,5 g/ℓ and a pH of 3,51. SO_2 was added to a concentration of 34 mg free SO_2/ℓ and 70 mg total SO_2/ℓ. Two of the replications of *L. oenos* strain Ia8 completed MLF within 18 days after inoculation and three within 21 days. The only other cultures which completed MLF before the control were *L. oenos* strain Ca3 of which two of the replications completed the fermentation within 35 days and three completed MLF within 39 days, and one replication of *L. oenos* ML34 which also completed the fermentation within 39 days. All the replications of the *Lactobacillus* cultures and the controls as well as four of the replications of *L. oenos* ML34 completed MLF within 46 days. Microscopic examination of the lees of the wines showed that the replications of the two *Lactobacillus* strains were contaminated with leuconostocs.

Once again it was *L. oenos* strain Ia8 which completed MLF much faster than any of the other bacterial cultures and this isolate should receive more attention for induction of MLF in future.

WINE

MICROBIOLOGY

(S)WI.73/1: THE EFFECT OF MUST NITROGEN COMPOSITION ON FERMENTATION RATE AND WINE QUALITY. 1979-1982

T.J. van Rooyen

This investigation was done to determine the effect of nitrogen deficiencies in grape must on yeast activity and wine quality. Past and present research was evaluated in a literature study on nitrogen compounds before, during and after fermentation, with special reference to amino acid composition.

Different musts were obtained from a soil cultivation trial in which nitrogen deficiencies had been shown to be the cause of lagging and stuck fermentations. The musts were fermented separately and samples were drawn on a regular basis. Yeast activity was measured by live suspended cell counts and the decrease in sugar concentration. The nitrogen compounds determined were: total nitrogen (Kjeldahl), protein nitrogen, free alpha-amino nitrogen (FAN) as well as 36 amino acids and related amino compounds. Sixteen volatile compounds (esters, higher alcohols and fatty acids) were determined in the wines. Wine quality was judged by a panel using a hedonic nine-point score card, as well as by ranking.

Total nitrogen and free alpha-amino nitrogen contents were found to be in the same range as previously reported for South African musts.

The differences in nitrogen content between the musts used in this study were not as marked as had been recorded during the previous four seasons. The overall time of fermentation, ranging from 46 to 56 days, is unacceptably long and can be regarded as lagging fermentations. Nevertheless, significant differences in the rates of fermentation were found.

The rates of fermentation correlated positively and significantly with the initial concentrations of the nitrogen compounds: total nitrogen, FAN, methionine + cysteine, ammonia and arginine, as can be seen from Table 1.

TABLE 1 - Correlation coefficients and significance of correlations between nitrogen compounds and the maximum daily rate of fermentation

Compounds	Correlation coefficient	Significance
Total nitrogen	0,960	**
FAN[1]	0,900	*
Methionine + cysteine	0,970	**
Ammonia	0,955	*
Arginine	0,889	*

[1] Free alpha-amino nitrogen
**Highly significant ($P \leqslant 0{,}01$; $r = 0{,}959$)
* Significant ($P < 0{,}05$; $r = 0{,}878$)

Between musts, the differences in changes in concentration of nitrogen compounds corresponded with the differences in yeast activity during fermentation. Significant negative correlations between the rates of fermentation and percentage consumption of FAN, asparagine, alanine and arginine were found. The results were in accordance with other workers who indicated that limited available nitrogen during fermentation led to a more complete assimilation of the nitrogen. Our experimental results also showed that the greater yeast activity caused the greater amounts of esters to be formed and correlated significantly with the quality preference during ranking.

Although significant difference between musts in the FAN concentration and yeast activity in different musts had been determined, no such difference could be shown for specific amino acids. Therefore a lower concentration limit of certain nitrogen compounds to ensure a complete fermentation could not be established. Further research in which a more detailed study of nitrogen uptake from different nitrogen sources by yeasts must be investigated, needs to be done in order to understand the nitrogen/fermentation rate interaction.

Citrus and Subtropical Crops

CITRUS

NUTRITION

(S)N.114/4: NUTRITIONAL REQUIREMENT OF CITRUS: SUITABILITY OF DIFFERENT SOURCES OF MAGNESIUM. 1974-1981
S.F. du Plessis

The purpose of this investigation was to evaluate the use of different sources of magnesium to rectify magnesium deficiencies of citrus.

Magnesium nitrate sprays were found to be quick reacting and very successful in increasing the Mg status of citrus trees. Magnesium nitrate can be used under acid and alkaline conditions, the only limiting factor being the lack of any residual effect in the next season. Annual applications are therefore a necessity.

Magnesium oxide at the rate of 2 kg per tree was fairly quick acting and provides sufficient magnesium for a few seasons. This product can, due to its alkaline reaction, only be used on acid to almost neutral soils.

Dolomitic lime is a cheap source of magnesium, slow acting and needs fairly large yearly applications to be of any value. In this experiments a 5 kg per tree application for three successive years was needed to alleviate the magnesium deficiencies. Dolomitic lime can only be used on acid soils.

Magnesite and magnesium sulphate were very slow acting and only increase the Mg status of the trees three years after fairly large annual applications. These products had no effect on the soil pH.

Despite the low Mg levels and abundant Mg deficiency symptoms that were encountered in this investigation no effect on yield or fruit size was obtained with any of these magnesium applications.

CITRUS

PATHOLOGY

W.P.Burger: ALLELOPATHY IN CITRUS ORCHARDS.
[Research Projects (S)N.82/6 and (S)N.82/9]
Ph.D.(Botany):University of Port Elizabeth. 1981
Supervisor: Prof. J.G.C. Small

In South Africa the replant problem of citrus has reached such serious proportions in the Sundays River Valley (SRV) that the economic viability of large production areas is threatened.

A field trial has shown that the magnitude in the growth reduction of trees grown in old citrus soil was influenced by the rootstock species, root parasites and soil conditions. It was found that the elimination of citrus nematodes by means of DD fumigation and the improvement of soil aeration by way of deep ploughing, significantly increased the growth and yield of citrus trees planted in old citrus soil. Soil where Valencia trees on rough lemon rootstock had grown previously, caused the greatest reduction in the growth of a second planting of Valencias which were budded on rough lemon. Although trees on Troyer citrange rootstock were the least affected by the old citrus soil, trees on Empress mandarin gave the best overall performance.

The results of the investigation of allelopathy in citrus soils have provided evidence that under certain unfavourable soil conditions, potent phytotoxins might be produced or liberated in the soil during the decomposition of citrus roots. Citrus soils in the SRV contain acid-ether extractable substances which caused a severe reduction in rough lemon radicle growth. It was found that these substances tend to accumulate in the soil layers below 500 mm depth. Laboratory investigations revealed that these phytotoxins could be produced by the anaerobic decomposition of rough lemon root residues. Homovanillic acid has been tentatively identified as the major growth inhibitor occurring in partly decomposed rough lemon roots. This phytotoxin caused a cessation of root cell elongation and the stimulation of radial cell expansion. The net result of this change in cell growth polarity was an arrest in root elongation and a swelling of the root tip.

An additional group of four lipid soluble phenolic compounds was found in fresh and partly decomposed citrus roots. Although these compounds were not as toxic as those found in the acid ether fractions, they appeared to be involved in the growth regulatory system of citrus roots. Two of the compounds have been positively identified as the pyrano coumarins, seselin and xanthyletin. The growth

inhibitory action of the four compounds was found to be concentration dependent. They occurred in different concentrations in rough lemon, Empress mandarin and *Poncirus trifoliata* rootstocks, which suggest a relationship to growth vigour. These compounds could be a valuable aid in the prediction of rootstock vigour as well as for chemotaxonomy.

The toxicity of seselin, occurring in non-injurious concentrations in low salt solutions, increased dramatically when the salinity of the nutrient solutions was increased from 95 mS m^{-1} to 177 mS m^{-1}. It was also found that the substitution of Cl^- with $SO_4^=$ as the associated anion of Na^+, caused a great increase in the toxicity of seselin at low concentration levels, even when the total salts concentration of the growth medium was kept constant. This could mean that organic inhibitors such as seselin occurring in the saline soils of the SRV would be more toxic than in the soils from Nelspruit. Furthermore, this could imply that soil treatments such as the reclamation of alkaline soils with $CaSO_4$ or fertilisers such as $(NH_4)_2SO_4$ and K_2SO_4 would also cause an increased toxicity of these compounds occurring in relatively non-injurious concentrations in citrus orchard soils.

Pot experiments indicated that the growth reduction of four rootstocks in citrus soil from the SRV was mainly associated with unfavourable physical/chemical soil conditions, whereas, biological soil factors were the main cause in Nelspruit soil.

In comparison with rough lemon, Troyer citrange and Empress mandarin, Swingle citrumelo rootstock was the least affected by old citrus soil. Rough lemon root residues added to a virgin soil, inhibited the growth of rough lemon seedlings, whereas *Poncirus trifoliata* roots had no effect.

The phenolic compounds in the roots and the mineral composition of the leaves were significantly affected by soil and biological factors. The majority of these components were differentially affected by the rootstock species, as well as physical/chemical and biological factors operative in citrus soil. Furthermore, the complex interactions which have been found to exist between these components in their relationship to growth, made it difficult to discern between cause and effect.

It can therefore be concluded that the study of old citrus soil as a gross environment in the investigation of allelopathy, is at best a futile exercise. Progress has, however, been made with the development of more sophisticated methods to study the effect of allelopathic agents occurring in old citrus soil by means of a rough lemon seedling bio-assay and miniature root laboratories.

This attempt to explore the dimensions of allelopathy in citrus orchards has shown that potent phytotoxic substances can be produced in the fine-textured alkaline soils where the replant problem is prevalent. With the available information, these findings cannot be extrapolated directly to actual field conditions. The possible existence of two mechanisms involving allelopathy in citrus orchards can, however, be suggested.

(a) When citrus soils in the Sundays River Valley are cropped to citrus, a marked decline in the numbers of beneficial fungi such as *Trichoderma viride* occurs. As these fungi are capable of breaking down phenolic compounds in the soil, their absence would lead to the accumulation of these compounds. In sufficient quantities they could affect citrus directly by causing a reduction in growth.

(b) Since phytotoxic substances in the soil can have a broad spectrum of injurious effects on the roots of plants, such compounds might be important in the relationship between the plant and root parasites. As phytotoxins are often produced in wet, anaerobic soils, these results could amongst others, explain why root rot diseases are usually prevalent under such conditions. Temporary anaerobic conditions existing for periods of 3-6 days after a heavy irrigation might be sufficient to produce enough toxic compounds to predispose the roots to fungal invasion. The available evidence indicates that there is a strong possibility that compounds produced in the fine-textured alkaline soils found in the regions showing a replant problem, might be implicated in the etiology of citrus root diseases. These toxins could modify a variety of physiological processes in the host roots in such a way that the natural resistance to root parasites, even those that are normally saprophytic, is lost. These could include the citrus nematode, *Phytophthora* spp. and low grade pathogens such as *Fusarium* fungi.

It is therefore suggested that the interaction between allelopathic agents and organisms occurring predominantly in citrus soil, might be the primary cause of the replant problem of citrus. An investigation of this hypothesis may provide a better insight into the basic causes of the citrus replant problem.

PINEAPPLES

PATHOLOGY

(S)N-OL.8/7: DISEASE CONTROL IN PINEAPPLES: INCIDENCE, GEOGRAPHIC DISTRIBUTION AND SEASONAL OCCURRENCE OF ABNORMALITIES AND DISEASES. 1974-1981
E.R. Dalldorf

A survey was carried out to determine the incidence of leathery pocket, black heart, black spot and sunburn, by the weekly examination of Smooth Cayenne pineapple fruit delivered to the four major canning factories in East London, from farms in the Kei Mouth, East London, Peddie, Bathurst and Alexandria areas.

There is a tendency towards an increasing occurrence of leathery pocket with southward progression in latitude, with the peak infestation from February to July.

The incidence of black spot reached a peak in April—May for most areas over the survey period.

Black heart peaked during July—August when some of the coldest days are experienced in the Border area, whilst in the cooler southern areas there was a greatly extended period when the incidence of black heart took place.

In all production areas sunburn injury was most prevalent from October to April when day temperatures exceeding 35 °C are often recorded.

The survey confirms that climatic conditions play a major role in the severity and incidence of the diseases and disorders studied.

PLANT PROTECTION RESEARCH

Entomology/Zoology

INSECTS

BIOLOGICAL CONTROL

(A)I-Pr.87/3: THE BIO-ECOLOGY OF THE POTATO TUBER MOTH: THE LEVEL OF CONTROL NOW EXERTED BY IMPORTED NATURAL ENEMIES AND THE MEASURES, IF ANY, NEEDED TO IMPROVE IT. 1976-1980.
E.F. Whiteside

Copidosoma koehleri and *Apanteles subandinus*, two parasites of the potato tuber moth in South America, were imported into South Africa in 1965—69 and spread rapidly to all potato-growing areas. They largely replaced the five indigenous species and raised the incidence of parasitism in moth larvae infesting potato crops. Maximum parasitism was 65 % before the importations and over 90 % afterwards. This high parasitism failed to keep field infestations down to safe levels only when rainfall was deficient. At such times insecticide applications were necessary. Up to four applications per season did not reduce parasitism. A simple rule was devised by which farmers can decide when insecticide must be applied to supplement biological control by parasites. It is based on a relationship that was discovered between rainfall and changes in tuber-moth populations. The rule was shown to work satisfactorily in tests on four farms in 1979—80.

An attempt was made to control tuber moth with a granulosis virus first discovered in 1974. Virus suspension was sprayed on infested plants in a potato field. The incidence of granulosis reached about 80 % in moth larvae in the sprayed area, but only after seven weeks, which is too slow for the virus to be of any use as a control measure.

Parasitism rose each year from about 20 % in spring to over 90 % (often 95 %) in January, regardless of potato variety, rainfall, size of larval population, incidence of granulosis virus and number of insecticide applications provided these did not exceed four. Even eight applications reduced parasitism by only 22—37 %. Thus biological control by parasites is permanently and firmly established. This probably accounts for the fact that the general incidence of 'moth damage' in potatoes inspected at municipal markets began to fall in 1965 and has remained at a low level ever since.

On average, indigenous parasites now account for only about 10 % of the total parasitism. The two introduced parasites predominate alternately in a regular cycle each year. *Copidosoma* is the more numerous in late summer, winter, and briefly in spring; *Apanteles* predominates in the middle of the growing season. This annual cycle was shown to be probably mediated by the foliage density of the potato plants. When dense foliage was induced early in the season, *Copidosoma* predominated throughout, but the total parasitism was not raised.

It is concluded from these studies that the imported natural enemies afford adequate control of potato tuber moth during periods of normal or above-normal rainfall, and that when rainfall is deficient, biological control can be safely and effectively supplemented by application of insecticides.

Publications

WHITESIDE, E.F., 1980. Biological control of the potato tuber moth (*Phthorimaea operculella*) in South Africa by two introduced parasites (*Copidosoma koehleri* and *Apanteles subandinus*). *J. ent. Soc. sth. Afr.* 44, 239-255.

WHITESIDE, E.F., 1981. The results of competition between two parasites of the potato tuber moth, *Phthorimaea operculella* (Zeller). *J. ent. Soc. sth. Afr.* 44, 225-232.

WHITESIDE, E.F., 1981. The potato tuber moth. *Agrivaal* 3(1), 1-8.

INSECTS

BIOLOGICAL CONTROL

(A)I-Pr.149: A TAXONOMIC STUDY OF THE BRUCHIDAE (COLEOPTERA) ATTACKING SOUTH AFRICAN *ACACIA* SPECIES. 1978-1981
S.J. van Tonder

In recent years attention has been given to the feasibility of importing seed-attacking insects from Australia in an attempt to curtail the aggressive spread in South Africa of eight Australian species of *Acacia* that have become naturalised in various parts of the country. As a component of this research programme, it was considered necessary to acquire some knowledge of the more important insect enemies of South Africa's native acacias.

Forty-five indigenous *Acacia* species occur in South Africa and of these 41 species were collected for the purpose of recovering Bruchidae. The remainder are restricted to isolated and rather inaccessible areas. No bruchids emerged from the seeds of *Acacia exuvialis, Acacia swazica* and *Acacia newbrownii*, while only small numbers of bruchids emerged from the seeds of *Acacia mellifera, Acacia arenaria, Acacia tenuispina* and *Acacia albida*. These short series were omitted from this study since long series are necessary for detailed study.

A total of 3 300 bruchids from 33 species of *Acacia* were studied. Twenty-three bruchids were studied taxonomically and those additional species collected but not studied in detail are listed. Of all these species, seven appear to be new and are described. In addition to the descriptions, keys are provided to all the genera and species studied. Insects other than Bruchidae were collected out of the seeds of many of the acacias and were identified where possible.

INSECTS

BEHAVIORAL STUDIES

(A)I-Pr.94: THE DEVELOPMENT OF LAYING WORKERS IN THE CAPE HONEYBEE AND ITS INFLUENCE ON THE SOCIAL ORGANISATION OF THE COLONY. 1962-1981
R.H. Anderson

In an attempt to preserve and describe the unique Cape honeybee, various bee colonies in Western Cape nature reserves and sanctuaries were located and monitored. Unfortunately, progress was made very difficult by the loss of colonies through human interference and the bees abandoning sites. The difficulties of marking colonies so that they could be re-located also hampered progress.

The average values of wing-vein measurements indicated a high degree of homogeneity between the various Cape bee colonies monitored.

INSECTS

ENTOMOLOGY

T-Rp.35/1 & 2: A STUDY OF REPRESENTATIVE SPECIES OF THE GENUS *PROTOSTROPHUS*. 1971-1982
H.H. Gouse

The distribution patterns of *Protostrophus amplicollis, P. barbifrons, P. convexicollis, P. hamaticollis, P. hirtiventris, P. sulcatifrons* and *P. vorax* in the Transvaal Region are compared with respect to the clay content of the soil, vegetation, altitude and rainfall. *Protostrophus* beetles prefer sandy and loamy soil types. The biological adaptations of different species can often be traced back to the environmental conditions where they occur.

The effect of temperature and humidity on the hatching percentage and the duration of the incubation period of the eggs of *P. amplicollis, P. barbifrons, P. brevicollis, P. hamaticollis, P. hirtiventris* and *P. sulcatifrons* was investigated. The threshold temperatures for embryonal development and the thermal constants were determined. The effect of temperature and humidity on the development of the eggs was compared with environmental factors in the areas of distribution of the species.

The morphology of *Protostrophus* larvae is discussed and those of *P. amplicollis, P. barbifrons, P. brevicollis, P. hamaticollis, P. hirtiventris, P. spinicollis* and *P. sulcatifrons* were compared. According to the morphology of the larvae the genus *Protostrophus* belongs to the tribe Cneorrhinini and not to the tribe Strophosomini, where it has previously been classified.

The vertical distribution of the larvae of *P. spinicollis* in the soil, the average mass of the larvae and the biomass were studied for one year. The study showed that the bulk of the larvae occur in the upper 300 mm of soil throughout the year. This is apparently caused by the availability of food in the upper layers of the soil. Seasonal vertical migrations are caused mainly by soil moisture conditions. The duration of the larval stage under natural conditions varies between 8 and 12 months. The larvae are very resistant to starvation and may possibly survive in the soil without food for as long as two years.

In most species of *Protostrophus* pupation takes place during October and November. The duration of this stage varies between 7 and 21 days, depending on the temperature. The adults of *P. barbifrons, P. brevicollis, P. convexicollis, P. crinitus, P. hirtiventris, P. spinicollis, P. gratus, P. perditor* and *P. sulcatifrons* appear during October and November. Their numbers reach a peak during December and January and they disappear in April. The numbers of *P. amplicollis* and *P. hamaticollis* also increase from the end of October. *P. amplicollis,* however, is most abundant during the period January to March, while *P. hamaticollis* achieves its maximum numbers every second year during the winter. *P. amplicollis* and *P. hamaticollis* are the only species of which adults are found also in winter.

The longevity and oviposition period of *P. sulcatifrons* females are longer than those of *P. hirtiventris,* and *P. sulcatifrons* also has a higher fecundity. The pre-oviposition period of *P. hirtiventris* is two weeks. The times of day when eggs are laid and the oviposition behaviour of five *Protostrophus* species were compared. The locomotory activity of four species were compared. The lower activity of *P. amplicollis* as compared with that of *P. barbifrons* explains why the former is parasitised to a higher degree by *Pandelleia dimorphia* than the latter.

The reproductive organs of different *Protostrophus* species are described and compared.

Two internal parasites of adult *Protostrophus* beetles were found, *viz Pandelleia dimorphia* (Tachinidae, Diptera) and a species of *Perilitus* (Braconidae, Hymenoptera). *P. dimorphia* is widely distributed and parasitises a wide range of *Protostrophus* species as well as other curculionids. The larval and pupal stages of this parasite are completed within the body of the host, which dies before eclosion of the adult fly. Parasitism of *P. amplicollis* by this parasite is highest between mid-December and mid-January. The biology and reproductive organs of *P. dimorphia* are described. The *Perilitus* parasite of *Protostrophus* is found in the Transvaal Middleveld and Highveld and it attacks several *Protostrophus* species. The biology and life cycle of this parasite, which is arrhenotokous, are discussed.

Other natural enemies of *Protostrophus* are birds and spiders. A fungus, *Beauveria bassiana,* kills the beetles under humid conditions.

The implications of the general biology of *Protostrophus* for the control of this pest are evaluated.

INSECTS

PESTS

E.M. Nevill: STUDIES ON *PARAFILARIA BOVICOLA* TUBANGUI IN SOUTH AFRICA WITH PARTICULAR REFERENCE TO THE ROLE PLAYED BY INSECTS IN ITS TRANSMISSION AND DISTRIBUTION. D.Sc.: University of Pretoria. 1980
Supervisors: Prof. J.J. Matthee and Prof. I.G. Horak

Parafilaria bovicola lives under the skin of cattle and is the cause of slimy, bruise-like lesions on carcasses. Trimming and down-grading can result in serious economic losses. In the live animal the female worm makes a hole to the outside and lays her eggs into the blood which drips from this hole.

Field studies in the Transvaal Bushveld led to the discovery of three vector flies, *Musca lusoria, Musca xanthomelas* and *Musca* sp. A. All three species belong to the subgenus *Eumusca* and only female flies were infected in the field. They breed in cattle dung in the veld and feed on wounds and lachrymal secretions on cattle.

Of 20 375 flies collected and examined on Bushveld farms, 64 % were vector flies and of these only 64 were infected.

Musca lusoria appears to play the major role in transmission as it is relatively abundant throughout the year with infected flies found between July and March. *Musca* sp. A. is only abundant from February to April but is important as a vector from February to May. *Musca xanthomelas* was never present in large numbers and was only infected from August to December when many infective blood spots were available. *Parafilaria bovicola* has probably not become established on the Highveld because of the lower temperatures which could limit vector numbers, especially during the critical spring period.

Laboratory studies showed *M. lusoria* to be larviparous and *M. xanthomelas* oviparous. Although the reproduction potential of *M. xanthomelas* is greater, *M. lusoria* is better equipped to survive.

Nearly 24 000 Bushveld cattle were examined for blood spots. Bleeding showed a seasonal periodicity with a peak in September. This seasonality is probably related to sunshine or rising atmospheric temperatures. The earliest blood spot in a calf was recorded 191 days after birth.

Bulls had the most blood spots followed by first year oxen and heifers, then second year oxen and heifers. Very few breeding cows bled because immunity can possibly be related to high female hormone levels. Over 92 % of all blood spots were on the dorsal and lateral body regions and nearly 60 % on the shoulder and rib areas. The distribution of carcass lesions was fairly well correlated with the distribution of blood spots.

Experimental infection of *M. lusoria* and *M. xanthomelas* showed that *P. bovicola* could develop to the infective 3rd stage larva and escape from the mouth-parts in both fly species. Development took place mainly in the fat-body cells of the abdomen and at 27 °C larvae took nine days to reach the 3rd stage.

Cattle were artificially infected via the subcutis, the eyes, skin incisions, and intravenously (jugular vein) or when infected flies fed on wounds. For transmission to continue, female animals and oxen must be reinfected annually but bulls possibly only biennially.

This investigation has revealed many aspects which require further study, perhaps the most important of which is the overwintering mechanism(s) of the three vector species.

INSECTS

PESTS

(A)I-Pr.115/1: THE BIO-ECOLOGY AND CONTROL OF CYST-FORMING NEMATODES IN SOUTH AFRICA: THE POTATO CYST NEMATODE, *GLOBODERA ROSTOCHIENSIS* (WOLL).
1972-1978
K.P.N. Kleynhans

From a study of the bio-ecology of the potato cyst nematode, *Globodera rostochiensis,* carried out between 1978 and 1980, this nematode pest appears to have adapted better to conditions on the East and West Rand rather than to those in the Bon Accord area near Pretoria. The continued persistence of *G.*

rostochiensis in the Rand soils and its rapid increase in numbers under the cultivation of host crops could encourage its spread to other potato producing areas of the Transvaal Highveld. It is possible that the potato cyst nematode is already present in these areas but at a non-detectable level because its numbers are suppressed by current crop rotation programmes. It is considered that crop rotation while not effective enough to prevent the eventual spread of the potato cyst nematode, will certainly delay it. It is recommended that periodic surveys for the detection of this nematode in the potato growing areas of the Highveld be carried out, especially in cases where unexplained decreases in yield are reported.

The limitation of *G. rostochiensis* populations to the Rand and Bon Accord appears to be related to the farming practices and the location of these areas. The small-holdings are all located near large cities and the potatoes are grown under irrigation with little or no crop rotation. No seed potatoes are produced.

The chemical control of the potato cyst nematode is expensive but gives rapid and excellent results. Potatoes can also be grown profitably in the presence of the nematode provided that a period of fallow, or rotation with non-host crops, is maintained for at least three years between successive potato crops. During this three-year period, all volunteer potatoes and weeds, especially weeds belonging to the Solanaceae, should be eradicated.

RODENTS

BIOTESTING

PB.2165/20/1/1: [(A)I–Pr.101/1]

THE COMPARATIVE EFFICACY OF EIGHT RODENTICIDES IN THE CONTROL OF THE GERBIL *TATERA BRANTSII.* 1969-1982

The efficacy of some acute and chronic (anticoagulant) rodenticides against *Tatera brantsii,* the Highveld gerbil, was investigated in laboratory and field tests. All rodenticides were tested in feeding tests, maize being the carrier.

The anticoagulants used in laboratory tests were brodifacoum (0,005 % and 0,002 %), difenacoum (0,005 % and 0,002 %), chlorophacinone (0,005 %), diphacinone (0,005 %) and warfarin (0,025 %), with and without sulphaquinoxaline, an antibacterial agent (0,025 %); acute rodenticides were zinc phosphide (2,16 %), pyriminyl (0,2 % and 0,5 %) and scilliroside (0,035 % and 0,05 %).

Laboratory tests included:

(a) no-choice tests, in which the toxicity of the rodenticides was determined as regards mortality, dosages that caused death and dosages that were survived and speed of action. (Anticoagulants were supplied for various feeding periods and acute poisons for a period of two days maximum);

(b) palatability tests, in which the acceptability of the rodenticides was examined and possible adverse-taste effects determined;

(c) choice tests, in which the efficacy of some anticoagulant rodenticides, when supplied in the presence of unpoisoned maize, was investigated.

Zinc phosphide and chlorophacinone were tested in two field tests, at Nooitgedacht Agricultural Research Station, Ermelo, and on a farm in the Belfast district. The acceptability of the former after pre-baiting was examined, as was the reliability of a baiting technique, using bait containers. Also brodifacoum (0,002 %) was studied in field tests on a farm in the Vereeniging district where its efficacy was determined by baiting "active" holes and bait containers.

Hundred per cent mortality was obtained with all rodenticides but scilliroside. Since a mortality rate of 14/15 was obtained with pyriminyl at 0,2 %, it was concluded that this rodenticide would give optimum efficacy at 0,5 %. Brodifacoum was the most active of all anticoagulants tested and can be effective at a 0,002 % concentration. Very little difference was found amongst difenacoum, diphacinone and chlorophacinone, which were all more toxic than warfarin (with and without sulphaquinoxaline).

The addition of sulphaquinoxaline to warfarin bait may have increased its efficacy only slightly; 100 % mortality was achieved at the six-day feeding period with warfarin plus sulphaquinoxaline, but only after 22 days' unrestricted feeding on warfarin alone.

Zinc phosphide caused all test animals to die between 45 min and 2 h after first poisoned food administration; survival time with pyriminyl ranged between 4 h and roughly 7 days.

Survival times of test animals suggest that the anticoagulants were very similar in their speed of action. There are, however, indications that the two indandione anticoagulants, diphacinone and chlorophacinone, may be slightly faster-acting than the 4-hydroxycoumarins. Survival times ranged between 3 days (chlorophacinone) and 22 days (warfarin).

It is probable that there exists no difference between the sexes of *T. brantsii* in their susceptibility to the tested anticoagulants; differences as regards mean lethal dosages, mortality and survival times observed for males and females were most often not significant. There also appears to be no sex-based difference in susceptibility to pyriminyl and zinc phosphide. Since no mortality was obtained in any of the tests with scilliroside, the presence of such a difference could not be determined.

The presence of diphacinone, chlorophacinone, or warfarin in maize seemed to have had no adverse effect on its acceptability to *T. brantsii*. Brodifacoum was mostly unacceptable at 0,005 % but not at 0,002 %. All animals on test could detect the inclusion of sulphaquinoxaline in the warfarin bait. Also scilliroside (0,05 %) was unpalatable to all test animals. Maize treated with difenacoum, zinc phosphide, and with pyriminyl (0,5 % and 0,2 %) was generally preferred to the unpoisoned alternative.

As regards the anticoagulant rodenticides, it was shown that body mass of test animals did not significantly influence their susceptibility, as reflected by lethal dosages and survival times. There were, however, indications that the heavier animals (that is animals in a better physical condition) were more tolerant to poisoning than the lean ones.

Observations on acute and anticoagulant rodenticides suggest that the amount of poisoned food consumed by animals that died in a test did not influence the period of survival until death occurred.

Results of warfarin tests in the present study were related to comparable results with *Rattus rattus, Rattus norvegicus, Mus musculus* and *Tatera indica. T. brantsii's* susceptibility to this rodenticide was found to be similar to that of *R. rattus,* less than that of *R. norvegicus,* but more than that of *M. musculus* and *T. indica.*

The efficacy of zinc phosphide was found to be improved by increasing the pre-baiting period from 4 nights (at Nooitgedacht) to 19 nights (at Belfast). At Nooitgedacht treatment resulted in a reduction of about 40 % in the population of *T. brantsii* on the study plot; at Belfast control success of more than 95 % was obtained.

Chlorophacinone application in the Nooitgedacht test resulted in reduction of more than 90 % in population numbers; at Belfast a reduction of more than 95 % was obtained.

Although baiting of the "active" holes of *T. brantsii* gave satisfactory results, poison treatment by using bait containers proved to be a more reliable method. Application of the first method resulted in about 80 % and 99 % decrease of gerbil numbers in two tests with brodifacoum (0,002 %), whereas the success of the latter method could be established as 91 % and 96 %.

The potential of rodenticides in baits can be determined by laboratory tests. Actual control success in field situations is dependent on other factors such as feeding behaviour and the susceptibility of a population, as influenced by population pressure and population composition.

RODENTS

CHEMICAL CONTROL

(A)I-Pr.101: STUDY OF THE BIOLOGY, ECOLOGY AND CONTROL OF MICE AND RATS AS AGRICULTURAL PESTS. 1969-1981

S. Stiemie

The efficacy of some acute and chronic (anticoagulant) rodenticides against *Tatera brantsii,* the Highveld gerbil, was investigated in laboratory and field tests. All rodenticides were tested in feeding tests, maize being the carrier.

The anticoagulants used in laboratory tests were chlorophacinone (0,005 %), diphacinone (0,005 %) and warfarin (0,025 %), with and without sulphaquinoxaline, an antibacterial agent (0,025 %); acute rodenticides were zinc phosphide (2,16 %) and pyriminyl (0,2 % and 0,5 %).

Laboratory tests included:

(a) no-choice tests, in which the toxicity of the rodenticides was determined as regards mortality, dosages that caused death and dosages that were survived and speed of action. (Anticoagulants were supplied for various feeding periods and acute poisons for a period of two days maximum);

(b) palatability tests, in which the acceptability of the rodenticides was examined and possible adverse-taste effects determined;

(c) choice tests, in which the efficacy of some anticoagulant rodenticides, when supplied in the presence of unpoisoned maize, was investigated.

Two field tests were done, at the Nooitgedacht Agricultural Research Station, Ermelo, and on a farm in the Belfast district. Zinc phosphide and chlorophacinone were tested. The acceptability of the former after pre-baiting was examined, as was the reliability of a baiting technique, using bait containers.

It is probable that there exists no difference between the sexes of *T. brantsii* in their susceptibility to the tested anticoagulants; differences as regards mean lethal dosages, mortality and survival times observed for males and females were not significant. There also appears to be no sex-based difference in susceptibility to pyriminyl and zinc phosphide.

Hundred per cent mortality was obtained with all rodenticides. Since a mortality rate of 14/15 was obtained with pyriminyl at 0,2 %, it was concluded that this rodenticide would give optimum efficacy at 0,5 %. Diphacinone and chlorophacinone were more effective than warfarin (with and without sulphaquinoxaline), resulting in higher mortality, at the shorter feeding periods in particular. A difference in efficacy between chlorphacinone and diphacinone may not be of any practical significance.

Zinc phosphide caused all test animals to die between 45 min and 2 h after first poisoned food administration; survival time with pyriminyl ranged between 4 h and roughly 7 days.

Survival times of test animals suggest that there is little obvious difference in the speed of action amongst the different anticoagulants. There are, however, indications that the two indandione anticoagulants, diphacinone and chlorophacinone, may be slightly faster-acting than warfarin, a 4-hydroxycoumarin. Survival times ranged between 3 days (chlorophacinone) and 22 days (warfarin).

The addition of sulphaquinoxaline to warfarin bait may have increased its efficacy only slightly; 100 % mortality was achieved at the six-day feeding period with warfarin plus sulphaquinoxaline, but only after 22 days' unrestricted feeding on warfarin alone.

The presence of diphacinone, chlorophacinone, or warfarin in maize seemed to have had no adverse effect on its acceptability to *T. brantsii*. However, all nine animals on test could detect the inclusion of sulphaquinoxaline in the warfarin bait. Maize treated with zinc phosphide and with pyriminyl (0,5 % and 0,2 %) was preferred to the unpoisoned alternative.

As regards the anticoagulant rodenticides, it was shown that body mass of test animals did not significantly influence their susceptibility, as reflected by lethal dosages and survival times. There were, however, indications that the heavier animals (that is animals in a better physical condition) were more tolerant to poisoning than the lean ones.

Observations on acute and anticoagulant rodenticides suggest that the amount of poisoned food consumed by animals that died in a test did not influence the period of survival until death occurred.

Results of warfarin tests in the present study were related to comparable results with *Rattus rattus, Rattus norvegicus, Mus musculus* and *Tatera indica. T. brantsii's* susceptibility to this rodenticide was found to be similar to that of *R. rattus,* less than that of *R. norvegicus,* but more than that of *M. musculus* and *T. indica.*

The efficacy of zinc phosphide was found to be improved by increasing the pre-baiting period from 4 nights (at Nooitgedacht) to 19 nights (at Belfast). At Nooitgedacht treatment resulted in a reduction of about 40 % in the population of *T. brantsii* on the study plot; at Belfast control success of more than 95 % was obtained.

Chlorphacinone application in the Nooitgedacht test resulted in reduction of more than 90 % in population numbers; at Belfast a reduction of more than 95 % was obtained.

The effect on the efficacy of the tested rodenticides of available natural food under different field conditions was not satisfactorily determined.

PESTICIDES

CHEMICAL CONTROL

(A)I-Pr.97/10: BREAKDOWN AND REDUCTION OF PESTICIDE RESIDUES: COMPARISON OF LOW AND HIGH VOLUME HAND SPRAYING IN RESPECT OF DEPOSITS AND PERSISTENCE. 1977-1981

L.P. van Dyk, H.A. Abbott and M. Krause

Ultra-low volume (ULV) application of pesticides has gained wide popularity. The aim of this investigation was to determine the size of the deposit delivered by ULV methods and whether ULV application gave more persistent residues than high volume (HV) application.

When endosulfan (35 % ec) was applied to cabbage, application rates of 20 mℓ in 10 ℓ water at 500 ℓ/ha and 1,8 ℓ/ha undiluted ec gave initial deposits of 211 and 190 mg/kg, respectively. These deposits degraded to 22 and 16 mg/kg, respectively, in 22 days. These differences are of no practical importance.

In a second experiment it was found that monocrotophos applied at rates of 250 mℓ/100 ℓ water/ha

(40 % ec) and 400 mℓ/ha (25 % ec) directly, with a turbair-tot ULV applicator, gave deposits of 1,47 (HV) and 0,35 mg/kg (ULV) on tomatoes. Residue studies were not undertaken but the low deposits would make high residues unlikely. The reason for the ULV deposit in this case is unknown.

With the application of 17,5 mℓ malathion (50 % ec) in 10 ℓ water and 1ℓ of undiluted ec to tomatoes in another experiment, it was found that the initial ULV deposits were higher than high volume deposits. However, after 7 days the ULV application gave lower residues. In both cases, residue levels were already below the 4 mg/kg maximum residue level after 2 h.

It can be concluded (though only provisionally) that the endosulfan and malathion ec's are suitable for ULV application, but the monocrotophos ec is unsuitable. No enhanced residue build-up was found with ULV application of any of the ec's but ULV application of the monocrotophos ec showed faster breakdown.

STORED GRAIN

PESTS

(A)I-Pr.24/3: THE USE OF RADIATION FOR THE CONTROL OF INSECTS IN GRAIN AND GRAIN PRODUCTS. 1970-1981

H.J. van Tonder

An important problem in the application of any type of control measure for the elimination of insects in stored grain and grain products is the large variety of insect species which may be present. When radiation is the control measure selected, the effective dosage must kill or sterilise the most radiation-resistant species present. However, to be economically acceptable, the lowest effective dosage must be used.

One of the main objects of this study was to determine the minimum effective radiation dosage necessary to kill each metamorphic stage or sterilise adult survivors and progeny of the following 11 test species:

Sitophilus oryzae
S. granarius
S. zeamais
Tribolium castaneum
T. confusum
Rhizophertha domnica
Oryzaephilus surinamensis
Ephestia cautella
E. kühniella
Plodia interpunctella
Sitotroga cerealella

There were large and divergent differences between the radiation sensitivity of the various species. As a group the Lepidoptera were more resistant to the lethal and sterilising effects of radiation than any of the Coleoptera species tested (especially if the dosage for sterility was used as the standard). In all cases the egg stage was the most sensitive to radiation damage and the larval and pupal stage increasingly more resistant with the adult stage the most resistant. The dosage required to obtain 100 % mortality with any of the various metamorphic stages largely depended on its age and the period of exposure to radiation. Depending on the species, a dosage of between 0,2 kGy to 0,5 kGy should be sufficient to effectively control any of the grain pests tested.

A radiation dosage for the control of insects in stored grain can be lower and more economical than 0,2 kGy if only the more sensitive Coleoptera species are present. A higher dosage of 0,5 kGy is required if the more resistant Coleoptera and Lepidoptera are present.

The lives of adult insects surviving irradiation are shortened and although they can still damage grain, this damage is very limited. The small number of progeny that these adults may produce are almost 100 % sterile as a result of the inherited genetic damage.

The surviving sterile adults can lend a degree of protection to grain against reinfestation (especially where the radiated population is large) because they compete with the non-irradiated insects for mates.

Where insects occur in seed grain, a dosage of about 0,1 kGy could be used for partial control but this is not recommended as genetic damage to the seed could affect properties such as its germination and potential yield. In this case use must rather be made of other conventional methods for insect control. The radiation treatments tested had no noticeable adverse effect on the taste, baking qualities and wholesomeness of the grain.

Plant Pathology/Microbiology

FUNGI

TAXONOMY

A.P. Baxter: A STUDY OF THE MORPHOLOGY AND TAXONOMY OF CERTAIN SOUTH AFRICAN SPECIES OF *COLLETOTRICHUM* CORDA.
[Research Project (A)PS-Pr.17/4]
M.Sc. (Botany): University of Pretoria. 1981
Supervisor: Prof. A. Eicker

The purpose of this study was to report on the culture characteristics of a variety of South African collections of *Colletotrichum* Corda, the development and morphology of conidiogenous cells, conidia, setae and appressoria and their usefulness in the taxonomy of the genus.

The extensive literature concerning the taxonomic and nomenclatorial history of *Colletotrichum,* its morphology, development and variability, was reviewed. Isolates were obtained from plant material collected by members of the Mycology Section, Plant Protection Research Institute, Pretoria, or from plant material or cultures received there for examination. Eighty-one isolates belonging to 12 subgeneric taxa were examined on host material and in culture. They were described and photographed in pure culture after incubation at 20 °C for 10 days under intermittent mixed irradiation, 12 h/day, from near ultra-violet and "daylight" type fluorescent tubes. Micromorphology was illustrated by means of line drawings together with light microscope and scanning electron photomicrographs.

Multivariate phenetic analyses of selected morphological and culture characters were performed in order to establish whether a practical species grouping statistically supporting traditional taxonomic groupings could be obtained. Ordination and various clustering techniques were employed.

A key to the species identified was constructed. Conidiogenous cells were found to be morphologically similar in the species studied, irrespective of whether they were present as discrete cells or incorporated into more or less complex conidiomata. There were no constantly associated discriminatory tendencies. Conidium ontogeny was constantly phialidic with occasional percurrent proliferation being observed. These facts indicate that *Colletotrichum* is a well-defined genus.

Characters which proved to be discriminatory at the species level were the presence or absence of setae; conidium width together with conidium shape, length and whether they are produced mainly from conidiomata or from hyphal side-branches, presence or absence of perithecia and texture and colour of marginal zones in culture. Other contributing factors were appressorium shape and width; presence or absence of sclerotia; colony growth rate and colour of colony reverse central zone. Characters which proved to be relatively unimportant in distinguishing between groups were the colour and texture of the colony central zone above; presence or absence and nature of zonation; the nature of colony margins in culture and the colour of conidial masses. Conidiophore structure and conidium ontogeny together with seta ontogeny, length, width and septation also did not contribute to species delimitation.

In the statistical analyses, isolates representing *C. dematium, C. graminicola* and *C. crassipes* were constantly grouped together, as were those representing the phenetically similar *C. trifolii* and *C. lindemuthianum.* The latter two taxa may possibly be considered to be two physiological forms of the same fungus, in which case the older name, *C. lindemuthianum,* should apply for the taxon. The latter, together with *C. musae* and *C. orbiculare,* should be regarded as separate species, not as host specific forms of *C. gloeosporioides,* as they are morphologically and culturally relatively distinct and have not been associated with *Glomerella cingulata,* the teleomorph of *C. gloeosporioides,* with certainty. The analyses illustrated the phenetic heterogeneity within the group of *C. gloeosporioides* isolates and confirmed the separation of *C. fructigenum* from this group. Isolates of the latter appear identical to *C. acutatum.* Although the name *C. fructigenum* has priority over that of *C. acutatum,* it appears to be more expedient to conserve *C. acutatum* against *C. fructigenum,* especially when the confusion surrounding the latter name is considered. The *C. coccodes* and *C. destructivum* isolates were interspersed. This may have resulted from their phenetic similarity or from the use of insufficient characters to discriminate between them, indicating the necessity for further investigation of these groups.

Pathogenicity tests were not carried out in the present study. Extensive investigation of the occurrence of physiological strains in *Colletotrichum* is necessary, however, from a plant pathological viewpoint, especially in the large, variable species such as *C. dematium, C. graminicola* and *C. gloeosporioides.*

In order to establish where the intrageneric discontinuities in *Colletotrichum* lie, large numbers of isolates of each currently recognised taxonomic species must be examined, both morphologically and pathogenically to ascertain the boundaries of their variability, and compared with type material as far as

possible. The consideration of characters displayed in pure culture together with the traditional morphological taxonomic characters and the application of statistical methods of evaluating these data, would significantly contribute to a sound basis for a more stable classification of *Colletotrichum* species. Until more detailed work can be done, the following *Colletotrichum* species may be recognised in South Africa: *C. dematium; C. graminicola; C. crassipes; C. coccodes; C. destructivum; C. musae; C. orbiculare; C. gloeosporioides; C. lindemuthianum; C. trifolii, C. acutatum (= C. fructigenum)* and *C. acutatum* f.sp. *chromogenum.*

FUNGI

TAXONOMY

(A)PS-Pr.41/1: THE FUNGUS FLORA OF ONION SEED. 1973-1982

G.C.A. van der Westhuizen and Magdalena van Rhÿn

The seed-borne mycoflora of onion seed produced in six different production areas in South Africa, *viz,* Pretoria, Karoo, Uniondale, Oudtshoorn, Douglas and Aughrabies, was studied to determine the species of fungi associated with the seed, the extent and frequency of the association, geographical distribution of fungi and changes in the flora that might affect germinability during storage.

One hundred and thirteen samples of seed collected over three seasons, *viz,* 1971/72, 1972/73, 1973/74, were studied by means of the blotter and malt-salt agar methods. Three samples of seed were stored for 39 months after harvest and examined periodically.

Sixty-four species of fungi from 28 different genera were found to be associated with the seed. The largest number of species belonged in *Aspergillus* and *Penicillium,* the former genus infecting from between 12,6 % in 1973/74 and 29,8 % of seed in 1971/72 and the latter 10,6 % in 1971/72 to 58,7 % in 1972/73. Of the known fungal pathogens of onion, *Alternaria porri* occurred on 1,0 % of seed only, *Botrytis* spp. on 6,1 % of seed in 1973/74 and *Fusarium* spp. varied between 5,5 % and 8,5 %. *Botrytis cinerea* was found on the seeds although it is not recorded as a pathogen of onion in South Africa. The species of *Fusarium* included *F. moniliforme, F. oxysporum, F. acuminatum* and *F. equiseti.*

Stemphylium vesicarium, the cause of leaf blight, was found on approximately half of the seeds infected by the genus. *S. vesicarium* has not been reported on onion in South Africa before but *S. botryosum* is known as a pathogen in the Western Cape.

Aspergillus niger, a cause of leaf mould of onion, and capable of inhibiting germination of onion seed, was found to be the most common seed-borne pathogen.

Differences in geographical distribution of pathogens were noted in the *Botrytis* spp. but did not occur in seed from the Douglas and Aughrabies areas and *Alternaria porri* and *Stemphylium vesicarium* occurred mostly in seed from the Uniondale-Oudtshoorn areas.

The low level of infection of the seed by pathogens indicates that seed-borne infection might not be epidemiologically important.

Low infection levels and retention of germinability at fair levels for long periods of storage indicate the high quality of South African onion seed.

BACTERIA

BACTERIOLOGY

(A)PS-Pr.21/16: SURVIVAL OF FAST- AND SLOW-GROWING *RHIZOBIUM* SPP. UNDER CONDITIONS OF RELATIVELY MILD DESICCATION. 1974-1980

H. Jansen van Rensburg and B.W. Strijdom

When subjected to desiccation with $Ca(NO_3)_2$ at 27 °C, strains of the fast-growing *Rhizobium meliloti* and *Rhizobium trifolii,* survived better than slow-growing strains of *Rhizobium japonicum* and of the "cowpea miscellany". At lower vapour pressures in a forced-draught oven, the pattern of survival changed and strains of slow-growing *Rhizobium* spp. withstood desiccation better than those of fast-growing species. The results are consistent with the interpretation that a lower internal water-retaining ability at any relative vapour pressure, renders strains of slow-growing *Rhizobium* spp. more resistant to severe

desiccation than strains of fast-growing species. It is suggested that under conditions of milder desiccation, this property is disadvantageous to the slow-growing *Rhizobium* spp. because insufficient moisture is available to allow for the functioning of vital enzymes.

BACTERIA

NITROGEN FIXATION

(A)PS-Pr.21/19: STUDIES WITH NITROGEN-FIXING BACTERIA IN SOUTH AFRICAN SOILS: DEVELOPMENT OF METHODS TO SELECT *RHIZOBIUM* STRAINS FOR INOCULANTS. 1975-1977

H.J. van Rensburg and B.W. Strijdom

A function of the Plant Protection Research Institute is to provide suitable strains of *Rhizobium* to commercial inoculant manufacturers. Strain selection is complicated by the availability of a number of strains which are indistinguishable with regard to nodulating and nitrogen-fixing abilities. Information on the ability of a strain to compete for nodulation with an established *Rhizobium* population is also lacking. A screening of strains for competitive abilities was therefore undertaken.

Twenty-four strains of *R. meliloti* considered to have potential for inoculant production, were grouped in pairs, and tested for capability to compete for nodulation on each of *Medicago sativa, M. truncatula* and *M. littoralis.*

Each pair of strains consisted of a wild type and a selected streptomycin resistant (Str^+) mutant of another strain. Good and poor competitors identified in this way in an autoclaved soil, reacted consistently when tested in each of five other autoclaved soils. When strains with comparable competitive abilities were paired, reactions varied.

An effect of soil pH on competitive ability was observed with some strains.

Not all strains identified as good competitors on one or more of the *Medicago* spp. in the autoclaved soils were able to nodulate these plants satisfactorily in a field soil containing an established population of *R. meliloti.*

Capability of a strain to compete for nodulation was apparently unrelated to its effectiveness or ability to survive in the field.

Two strains of *R. meliloti* frequently used for inoculant production, differed markedly with regard to competitive ability - this places some doubt on the relevancy of singling out competitive ability for special attention when selecting a strain for inoculant production.

The results of this study were presented for publication in Applied and Environmental Microbiology: "Competitive abilities of strains of *Rhizobium meliloti* considered to have potential as inoculant strains".

The relationship between root surface representation of *Rhizobium meliloti* and its ability to nodulate *Medicago sativa,* was also examined.

Nine strains of *R. meliloti* which ranged in competitive ability on *M. sativa* from excellent to poor in autoclaved soils, were paired in 29 combinations and used to inoculate *M. sativa* in a liquid rooting medium.

A positive correlation ($r = 0{,}545$) between strain ratios in nodules and root surface cell ratios was determined.

A significant relationship established between two root surface cell fractions representing firmly and loosely attached cells linked infectivity to the more firmly adsorbed cells.

The most competitive strains in autoclaved soils were also amongst the most prompt nodulators.

Results of the competition experiments in the liquid medium agreed in general with results obtained in autoclaved soils with the exception of one strain, RF 24, which grouped among the most competitive in soil and least competitive in the liquid medium.

The adsorption of cells of both infective and non-infective *Rhizobium* strains to roots of *M. sativa* and *Trifolium repens* was demonstrated; the ratios of loosely attached:firmly attached cells on the root surface were significantly narrower with the infective combinations than with the non-infective strain-legume associations.

The results of this examination were presented for publication in Applied and Environmental Microbiology: "Confirmation of a relationship between root surface representation of *Rhizobium meliloti* and ability to nodulate *Medicago sativa.*"

ENTOMOLOGY

PASTURE CROPS

NITROGEN FIXATION

(A)PS-Pr.21/21: STUDIES WITH NITROGEN-FIXING BACTERIA IN SOUTH AFRICAN SOILS: DETERMINATION OF THE SYMBIOTIC RELATIONSHIPS AMONG GENETIC LINES OF *MEDICAGO TRUNCATULA*. 1977-1980
B.W. Strijdom

Medicago truncatula is an important annual legume used in pastures in South Africa. In order to ensure that the many genetic lines and cultivars of this legume available, would be effectively nodulated when inoculated with a legume inoculant, it was deemed necessary to determine their abilities to fix nitrogen with various strains of *R. meliloti*

The symbiotic characteristics of 25 lines and five cultivars of *M. truncatula* inoculated with each of 16 strains of *R. meliloti* of diverse origin were determined.

The various lines and cultivars comprised a fairly homogeneous group although marked variation in the reactions of plants to individual strains was obtained. Of the five cultivars Borung, Jemalong, Ghor, Akbar and Cyfield, appreciable specificity with regard to strain requirements for effective nodulation was shown by Akbar and Jemalong.

Some strains of *Rhizobium* were able to induce an effective response with each of the lines and cultivars studied. However, these wide spectrum strains were not among the most effective ones.

It is concluded that a highly effective strain can be selected for any of the genetic lines tested if necessary. The strain of *R. meliloti* currently used in inoculants in South Africa is a wide spectrum strain. It forms effective nodules on all plants tested, but is not among the most effective on any of the lines tested.

Results of this study have been published in: *Phytophylactica* 12, 173-176 (1980).

Phytosanitary Research

ENTOMOLOGY

PESTS

(A)I-Pr.127: MORPHOLOGY, BIOLOGY AND CONTROL OF VINE MARGARODES (MARGARODIDAE MORR. AND TERMITOCOCCIDAE) IN SOUTH AFRICA. 1975-1980
C.A. de Klerk

Detailed morphological redescriptions were made of seven *Margarodes* species occurring on grasses and vines in South Africa, *viz, M. newsteadi, M. peringueyi, M. ruber, M. capensis, M. greeni, M. prieskaensis* and *M. trimeni.*

Various aspects of the biology of *M. capensis* Giard, a vine infesting species, were investigated under laboratory and controlled conditions. Adult females emerged from cysts from the end of November to the beginning of March. Peaks of emergence occurred during the third week of January or at the middle of February. Only 3 to 10 % of the cysts developed into adult females annually and females emerged during four successive years from a collection of cysts, even if the cysts were detached from their host plant and were not feeding. Females did not migrate to the soil surface for mating but reproduced parthenogenetically. The average oviposition period was 11 days and the average life-span 24 days. An average of 251 eggs were oviposited per female, the highest number being laid during the first four days. The effect of temperature, relative humidity and soil moisture on oviposition as well as on incubation of eggs was investigated.

Various aspects of the biology of *Margarodes capensis* Giard were also studied under field conditions. Cysts occurred throughout the year and although adult females can emerge without the cysts reaching their maximum size, the whole population of cysts does not develop into adult females annually. Adult females occurred from December to May with a peak from end February to middle March. First instar larvae were found from end February to end May. No males were found during the observation period of one year, indicating that females reproduce parthenogenetically.

Cysts were found in the soil to a depth of 1,2 m, the highest number occurring at a depth of

46-60 cm. The highest number of adult females occurred at a depth of 16-75 cm, and first instar larvae were found from a depth of 16 cm to 1,2 m in the soil.

Various aspects of the biology of *Margarodes vredendalensis* De Klerk, another vine infesting species, were studied. Under laboratory conditions adult females emerged during January and February, and only 10-16 % of the cysts developed into females annually. Although cysts were detached from their host plant, females emerged during four successive years from the same population. Adult females did not migrate to the soil surface for mating, and reproduced parthenogenetically. The average oviposition period of females was 18 days and their average life-span 40 days. An average of 507 eggs per female were oviposited, the highest number being produced during the first nine days. The effects of temperature, relative humidity and soil moisture on oviposition, as well as on incubation of the eggs, were investigated.

Cysts in the field were found to a depth of 1,2 m in the soil, the highest number occurring at a depth of 46-60 cm. The vertical distribution of cysts was directly related to the vertical distribution of roots. Significant negative correlations were also found between the vertical distribution of cysts and soil moisture, as well as the percentage clay of the soil.

Weed Research

WEEDS

CHEMICAL CONTROL

(A)T-Rp.115/1: CONTROL OF NUTGRASS (*CYPERUS ROTUNDUS*). 1967-1981
O.J. Olivier and P.J. Henrico

A project to control red nutgrass (*Cyperus rotundus*) was conducted at the Horticultural Research Institute near Pretoria. Six treatments were included and the experiments lasted for six years. Several soil cultivation treatments and a systemic herbicide (glyphosate) were decided upon. (Glyphosate known on sale as Roundup.)

The best treatment turned out to be two applications per annum of glyphosate - once in spring and once in late summer at a rate of 5,5 ℓ/ha repeated for two years. In addition the dry soil had been ploughed in winter to form large sods which were left undisturbed through winter and followed with a few cultivations with a tine implement later in summer. The nutgrass population was reduced to 0,2 % of the original number during the first three years. As soon as crop production was brought into this treatment the numbers of nutgrass again increased gradually.

It is recommended that regular spot spraying should be applied on lands where the population has decreased to a satisfactory level.

Regular cultivation for two years with a tine implement whenever the nutgrass emerged, plus winter sod ploughing caused a reduction of 85,5 % of the original population. As soon as crop production was brought in, the population again increased gradually.

In all the other treatments where vegetables and cover were included from the start of the project, the nutgrass population increased. This increase varied from 20 to 432 % of the original population.

WEEDS

ECOLOGY

(A)P-Pr.20/1: AN ECOLOGICAL STUDY OF GIFBLAAR, *DICHAPETALUM CYMOSUM* (HOOK.) ENGL. IN THE PRETORIA AREA. 1978-1980
J. Vahrmeyer

Although gifblaar [*Dichapetalum cymosum* (Hook.) Engl.] has been extensively studied from a biochemical viewpoint, comparatively little is known of the ecological relations of the plant. Gifblaar is of considerable economic importance because of its poisonous effects on livestock in southern Africa. In the literature no economically applicable, and at the same time effective methods of control or eradication could be found. Before such measures can be taken, it is necessary to know more about the life cycle of the plant, its distribution and ecology.

The density, frequency of occurrence and ecological relations of gifblaar were studied in a representative and varied area of about 2 400 km² around Pretoria. The physiognomy and general environmental factors of the research are described, and it is pointed out that the area is situated mainly in the transitional zone between the Highveld and the lower lying Bushveld.

Density and frequency values were obtained by using 1 m² quadrants in the gifblaar populations.

Strong correlation was found between the distribution of gifblaar and that of certain geological formations. The plant occurs only on acidic sedimentary formations and their residual soils and is absent from soils of igneous origin. With the help of geological maps the potential distribution area of gifblaar can now be pinpointed. This finding points to the importance of geology in ecological studies and to the value of plant distribution for geobotanical prospecting.

Gifblaar was only found on well drained soils. It was found neither on very coarse sand nor on poorly drained loam or clay. The depth of the soil is not an important factor in the distribution of gifblaar and has no marked influence on the density of the populations. The pH of the soil on which gifblaar occurred varied between 4,2 and 6,4 with an average of 5,2. The electrical resistance of the gifblaar soils varied between 2 900 and 15 000 ohm with an average of 6 160 ohm. This shows that the soils are leached to a high degree and that they are infertile. Base saturation and more specifically calcium saturation is one of the most important factors delimiting the distribution of gifblaar. In the veld gifblaar shows a very narrow tolerance to calcium concentrations. This phenomenon may find practical application in control or eradication measures.

The distribution of gifblaar in the research area illustrates a climatic barrier, and minimum atmospheric temperature appears to be the limiting factor. Rainfall and wind are less important factors in determining the distribution of gifblaar. Because the Pretoria district is situated on the edge of the distribution area of gifblaar the optimum climatic conditions under which gifblaar grows could not be determined.

As a rule gifblaar occurs in a typical plant community characterised by certain tree and shrub species (indicator plants). The best indicators in the research area are *Ochna pulchra* and *Burkea africana.*

In the research area gifblaar starts flowering in October. The number of flowers on a twig of gifblaar is very constant throughout the research area, varying between 19,8 and 21,9 with an average of 20,6 flowers per twig. During the flowering period an average of 12 % of the twigs in a population does not bear flowers.

Fruiting gifblaar is generally very rare, but during the 1968-1969 growing season about 200 fruits were collected. These were found only in a very small number of populations. Even in these populations only 0,68 % of the flowers develop into fruit. Under favourable climatic conditions during the 1968-1969 growing season the number of seeds produced by gifblaar was only one thousandth of the potential seed formation. Insects and unfavourable temperature and moisture conditions contribute to the unsuccessful propagation and establishment of gifblaar under present natural conditions.

Viable seed plant in the veld did not germinate, whereas seed planted under experimentally simulated forest conditions of high humidities and organic forest soil resulted in 97 % germination.

In the veld gifblaar grows very slowly and many plants in the research area must be very old.

Methods to propagate gifblaar successfully from seed and cuttings are described for the first time.

WEEDS

ECOLOGY

S.R. Fugler: DISTRIBUTION AND AUTECOLOGICAL ASPECTS OF THE HAKEA PEST PLANTS, *H. SERICEA, H. GIBBOSA* AND *H. SUAVEOLENS.*
[Research Project (A)P-Sb.5/2]
M.Sc.: University of Cape Town. 1979

The distribution of four *Hakea* species, *H. sericea, H. decurrens, H. gibbosa* and *H. suaveolens* in Australia was studied. *H. decurrens* is not one of the South African pest *Hakea* species but in Australia it has been taxonomically confused with *H. sericea.* It was found that *H. suaveolens* comes from a Mediterranean-type climatic region whereas *H. sericea, H. decurrens* and *H. gibbosa* grow in areas where the rainfall is more evenly distributed throughout the year. In South Africa the area infested by *H. gibbosa* and part of the area infested by *H. sericea* are in a Mediterranean-type climatic region. It is not an anomaly that these two species have become pests in this region. The lack of biological control agents, the moisture-bearing south-east winds which alleviate the summer drought, and a degree of drought

adaptation on the part of the plants account for their ability to invade indigenous veld.

The distribution of *H. sericea* indicates that certain improvements could be made to the present largely successful mechanical control programme conducted by the Department of Forestry. Two natural 'breaks', the Breë River and the Langkloof and its westward extension into the Little Karoo, can be used to prevent the northward advance of *H. sericea*. Although there are infestations to the north of these 'breaks' every attempt should be made to eradicate them because no suitable natural 'breaks' to the north of the Breë River and the Langkloof exist. There are several outlying infestations and some of these can be eradicated, but the others which cannot be easily eradicated must be prevented from spreading further.

The *H. gibbosa* distribution in South Africa indicates that it may be possible to eradicate the pest in all areas except one. The one area where eradication will probably prove impossible in the immediate future is the Kleinriviersberge and adjoining mountains. Fortunately, the area is likely to be proclaimed a Mountain Catchment Area and will be managed by the Department of Water Affairs, Forestry and Environmental Conservation.

The distribution of *H. suaveolens* in South Africa indicates that this pest could be totally eradicated.

Studies on the effectiveness and dispersal of biological control agents of *H. sericea* began shortly after the initial release of the insects. The effectiveness of these insects is determined by the proportion of seed that they destroy. A simple field method has been designed to permit the estimation of the proportion of seed on individual plants that is actually taken by the insects.

An investigation revealed that a linear, power and exponential relationship existed between stem circumference and the number of fruit on *H. sericea* plants. The exponential relationship was found to provide the closest approximation to the observed data. This relationship enables entomologists to estimate the number of fruit on *H. sericea* plants and thus to conduct an investigation to ascertain the effect that released biological control agents have upon fruiting of the plants. To estimate the effectiveness of these control agents for a stand of *H. sericea,* it is necessary to know the density of the plants in a stand. Plot studies were found to be the only method that could be used. A field method was then designed for use by entomologists studying success of insects released on *H. sericea* with a view to controlling the pest. This method is both practical and effective for the terrain that *H. sericea* infests. This method still requires testing at other sites before it can be used with confidence.

Selected aspects of the phenology of the three pest *Hakea* species were studied. Combined with information obtained from the stem-circumference/fruit-number relationship study it is possible to describe the growth strategy of *H. sericea*. In the early stages of the plants' life cycle, growth is an important priority. However, as an adaptation to high fire frequency, seedlings produce fruit as early as one year after germination. With age, fruit production becomes more important than growth. This is shown by comparing the growth of different age groups of *H. sericea*. Seedlings grow practically throughout the year, producing their main growth flush during the dry summer period. All three species drop the older leaves during the summer drought. However, this aspect requires further investigation. Summer growth flushes of *H. sericea* become less prominent as plants age, mature plants produce few strong flushes and over-mature plants hardly any.

The increase in the number of fruit on *H. sericea* follows an exponential curve when plotted against increasing stem circumference. The plant is, as it were, preparing for fire which becomes more probable as the vegetation matures.

H. gibbosa probably follows a similar growth strategy to *H. sericea*. However, *H. suaveolens,* unlike *H. sericea* and *H. gibbosa,* originates from a Mediterranean-type climatic region in Australia. *H. suaveolens* produces much less fruit than either *H. sericea* or *H. gibbosa*. Because it does not have the ability to spread as rapidly as the other species, *H. suaveolens* is not as aggressive as the other *Hakea* pests.

The growth of the three *Hakea* species was analysed by classical plant-growth analysis and the branching was analysed by a method similar to that of Bazzaz and Harper*. This work indicates that the leaf abscission that occurs during the summer period is triggered by some factor other than water availability. This factor could be day length or air temperature. Branching and secondary thickening occur at all of the seedlings' stem heights.

Future botanical research should concentrate on the most noxious *Hakea* pest, *H. sericea*. The integration of the existing *Hakea* control programmes should receive high priority, so that these programmes augment rather than hinder each other. To enable biological control agents to remain effective in areas that have been mechanically cleared, some *H. sericea* plants will have to be preserved to act as a food source. The distribution, density and age of these plants should be carefully selected to reduce the chances of unacceptable re-infestation by *H. sericea*. The survival of seed to seedlings producing their first fruit, should be studied for seed germinating at different times of the year. The best

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*BAZZAZ, F.A. & HARPER, J.L., 1977. Demographic analysis of the growth of *Linum usitatissimum*. *New Phytol.* 78, 193-208.

time of year to allow *H. sericea* seed to be released into the veld will then be known. Investigations into the drought response of *H. sericea* may provide clues which will enable the most effective time of year for cutting to be determined.

Unpublished reports

FUGLER, S.R., 1980. Report on the distribution and suggested management of the three South African pest *Hakea, H. sericea* Schrad., *H. gibbosa* (Sm.) Cav. and *H. suaveolens* R. Br.

FUGLER, S.R., 1980. The correlation between seed production and stem circumference in *Hakea sericea* Schrad.

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ANIMAL PRODUCTION PROMOTION

ANIMAL PRODUCTION AND ANIMAL PRODUCTS RESEARCH

Animal Type

BEEF CATTLE

NUTRITION

H-Ps.214/3: INTENSIVE BEEF PRODUCTION: PROTEIN REQUIREMENTS OF 18-MONTH-OLD OXEN DURING THE FINISHING PHASE. 1975-1981

H.J. van der Merwe

Eighteen-month-old Simmentaler steers with an initial body mass of 310 kg were divided into eight comparable groups of 10 animals each. The performance of steers at crude protein levels of respectively 9,1; 11,9 and 14,7 % in a maize silage ration (± 80 % silage dry matter) and 9,2; 10,2 and 12,9 % in a concentrate ration (± 80 % concentrate dry matter) was compared. The influence of a gradually declining crude protein level of 14,7 to 9,1 % and 12,9 to 9,2 % in both the silage and concentrate rations, respectively, was also investigated during the finishing period. The inclusion of 11,9 and 10,2 % crude protein in the silage and concentrate rations, respectively, resulted in maximum digestible energy intake/ $W^{0,75}$ kg/ day live mass gain and in maximum efficiency of feed conversion to carcass mass. Increasing the crude protein content of a silage ration from 9,1 to 14,7 % resulted in a non-significant increase in carcass mass and dressing percentage but a significant ($P<0,05$) increase in carcass grade. In the case of steers that were fed a concentrate ration with 9,2 % crude protein, carcass quality was not significantly lower than those fed a ration with 10,2 % or more crude protein. Feeding a declining as compared to a constant crude protein level during the finishing period, did not result in any significant differences. Dry matter intake, live mass gain, feed conversion to carcass mass and carcass quality of steers fed a silage, as compared to a concentrate ration, did not reveal great differences. The finishing of steers on a silage or concentrate ration with approximately 9 % crude protein, resulted in considerably lower economic returns than steers that received protein levels of respectively 11,9; 10,2 % or more. The inclusion of 9 % crude protein in a silage, as compared to a concentrate ration, resulted in higher economic returns.

TABLE 1 - Effect of protein content on performance of steers finished on two rations

Ration	Maize silage				High concentrate				Statistically significant differences
	9,1 %	11,9 %	14,7 % ↓ 9,1 %	14,7 %	9,2 %	10,2 %	12,9 % ↓ 9,2 %	12,9 %	P = 0,05
Crude protein content (%)									P = 0,01
Treatment No.	1	2	3	4	5	6	7	8	
Daily gain (kg/ steer/ day)	0,91	1,19	1,12	1,18	0,75	1,20	1,15	1,18	2, 3, 4, 5, 6, 7, 8> 5** 2, 4, 6, 8> 1*
Dry matter intake (kg/steer/day)	7,60	8,41	8,30	8,87	6,90	8,68	8,31	8,29	
(g/ $W^{0,75}$ kg/day)	93,30	98,00	97,40	101,10	84,70	97,80	97,11	96,60	
Crude protein intake (kg/steer/day)	0,69	1,00	0,98	1,31	0,63	0,88	0,84	1,07	
(g/ $W^{0,75}$ kg/day)	8,50	11,70	11,50	15,30	7,80	10,30	9,80	12,50	
Carcass mass (kg)	215,30	239,50	234,80	244,40	213,40	247,40	244,80	246,40	NS
kg feed/ kg carcass mass gain	13,33	11,52	12,03	11,52	13,53	10,85	10,65	10,49	-
Carcass grading (out of 20)	13,20	15,40	15,80	17,30	14,70	17,00	17,10	17,60	8> 1** 4, 6, 7> 1*

NS = Not statistically significant

BEEF CATTLE

NUTRITION

H-Ps.232/10: ENSILING AND SILAGE FEEDING: UREA-LUCERNE MEAL SUPPLEMENTATIONS FOR YOUNG CATTLE ON MAIZE SILAGE. 1972-1981

H.J. van der Merwe and M. von La Chevallerie

Four protein supplements to maize silage *ad lib.* for the finishing of weaner cattle (steers and heifers) were compared on an isonitrogenic and isocaloric basis. The four protein supplements were composed as follows:

(1) 47,6 % maize meal, 35,7 % groundnut oil cake, 11,9 % fish meal and 4,8 % urea (1,14 kg/animal/day) which served as a control treatment; (2) 3,6 % urea and 96,4 % lucerne (1,82 kg/animal/day); (3) 3,9 % urea, 88 % lucerne and 8,1 % fish meal (1,69 kg/animal/day); and (4) 2,2 % urea, 60,2 % lucerne and 37,6 % groundnut oil cake (1,45 kg/animal/day). Statistically similar results were obtained with steers and heifers with respect to reaction to treatments. Therefore, four groups of nineteen cattle each which were comparable with respect to mass, type and sex were used for final analysis.

No statistically significant differences in growth or carcass characteristics of cattle occurred. Feed conversion was less efficient in cattle that received the lucerne + urea + fish meal (± 10 %), lucerne + urea (± 8 %) and lucerne + urea + groundnut oil cake (± 5 %) supplements than in those receiving the control mixture. A statistically non-significant higher grading of cattle receiving the control and lucerne + urea + groundnut oil cake supplements than those receiving the remaining mixtures, was observed. The recommended protein supplement to maize silage *ad lib.* for the finishing of cattle will greatly depend on the availability and relative prices of the different protein sources.

DAIRY CATTLE

NUTRITION

W-Eb.93/8: THE INFLUENCE OF WEANING TECHNIQUE ON THE GROWTH AND DEVELOPMENT OF EARLY WEANED CALVES. 1978-1981

C.J.J. Brand and J. de K. van Dyk

General recommendations with respect to early weaning techniques suggest gradual weaning from milk at an early age. However, some workers maintain that better intakes of dry feed can be achieved by abrupt weaning. This technique is also considered to be less complicated and should consequently be more acceptable to the farmer.

Two groups consisting of 10 bull and 10 heifer calves each were used. Calves of Group A were abruptly weaned at 28 days of age after receiving milk at a rate of 10 % of body mass. Calves of Group B were also fed milk at the same rate up to 21 days of age. From this stage up to 30 days of age the calves received milk at a rate of 5 % of body mass in the morning only. After 30 days of age, milk feeding was discontinued. A calf starter was provided *ad lib.* to all calves from the second week of age. The composition of the starter meal is presented in Table 1.

TABLE 1 - Composition of calf starter meal

Component	Mass (kg)
Yellow maize meal	66
Groundnut oil cake meal	16
Fish meal	6
Lucerne meal	11
Mineral mixture*	1

*Mineral mixture consisted of equal parts of salt and a commercial mineral mixture

Drinking water was provided *ad lib.* from the start of the experiment.
Some results pertaining to live mass and food intake are presented in Table 2.

TABLE 2 - The mass and feed intakes of the calves at various ages

Component	Group A (kg)		Group B (kg)	
	Bulls	Heifers	Bulls	Heifers
Starting mass	36,0	31,0	34,0	30,8
Mass at 21 days	44,4	37,0	42,0	37,8
Mass at 42 days	57,7	48,6	55,6	48,5
Mass at 16 weeks	143,7	123,6	142,5	119,6
Total milk intake per calf	110,3	94,0	110,6	96,1
Starter intake, 22 to 42 days	21,6	18,2	19,9	18,4
Total starter intake per calf	245,3	217,0	239,4	217,0

From the results it is clear that no meaningful differences were found between the two groups and it is concluded that either weaning procedure may be followed with the same level of success.

DAIRY CATTLE

NUTRITION

W-Oq.18/2: THE MILK PRODUCTION POTENTIAL IN THE GEORGE AND KNYSNA AREA: EVALUATION OF FEEDING PRACTICES FOR DAIRY COWS. 1974-1981

C.J.J. Brand

The feeding value of maize silage and/or cultivated pasture as sources of roughage for dairy cows in the George and Knysna area was evaluated.

Jersey cows were allotted to three groups and fed limited (0,5 % of body mass) lucerne hay plus concentrates according to the stage of lactation. In addition, the cows received the following roughages:

Group A: Maize silage *ad lib.* plus cultivated pasture from 16 h 30 to 06 h 00.
Group B: Cultivated pasture only from 16 h 30 to 06 h 00 and again 07 h 00 to 10 h 00.
Group C: Maize silage *ad lib.* only.

Group B yielded the highest milk production but the lowest butterfat percentage. This group yielded the largest amount of butterfat. It would seem as if the roughage contained in the pasture and limited lucerne hay was inadequate to maintain a high butterfat percentage.

When maize silage was added to the diet, butterfat content of the milk increased. However, this was accompanied by a slight drop in milk production.

The milk production of cows receiving maize silage only, was significantly reduced.

Body mass changes of the cows in the respective groups followed a similar trend as total milk yield.

The experiment has shown that high milk production can be obtained on cultivated pasture supplemented with limited lucerne hay and concentrates or with maize silage, limited lucerne hay and concentrates. The specific maize silage offered was unable to furnish sufficient nutrients for a significant milk yield.

Although the best net profits were obtained with cows kept on pasture, the availability of irrigation water may affect the practicability of some cultivated pastures.

DAIRY CATTLE

PATHOLOGY

F. du Toit: COMPARISON OF STANDARDS FOR DETERMINING DISTURBANCES OF THE PHYSIOLOGICAL PROCESSES OF THE LACTATING UDDER.

[Research Project (A)VS-Pr.99/2]
M.Sc. (Agric.): University of the Orange Free State. 1980
Supervisor: Mr P. de Villiers

Mastitis is a disease which develops in the udders of dairy cows due to the undesirable domination

of leucocytes by pathogenic bacteria. There is practically no dairy herd which is not subjected to this disease. It has been determined that when 2 % of clinical cases of mastitis occurred in a herd an additional 48 % of the animals were infected with the subclinical form of this disease. The gross loss caused annually by mastitis in South Africa, amounted to approximately 25 % of the total income from the sale of milk.

This study was undertaken to determine the loss in milk production of each quarter of the udder in which subclinical mastitis was present and also to ascertain its influence on certain milk components.

The following parameters were determined: cell count as well as sodium, potassium, lactose, protein and fat concentrations in milk. Cell count is almost universally accepted as one of the indices of milk quality. The other parameters in this study can be ascertained just as easily and used as indicators of milk quality, as the cell count method.

This survey was carried out on milk produced during a 24 h period by 108 cows from 12 privately owned herds in the Central Free State. Milk analyses were done on 432 individual quarter milk samples, 216 cow milk samples as well as 12 compound mass milk samples.

It was found that infected quarters produced 37 % less milk than equivalent normal quarters. It was also established that the total cell count of infected milk was much higher than the cell count of milk from equivalent normal quarters. When the cell counts from infected quarters were converted to a percentage, based on those of normal quarters, the average increase was 1 079 %.

Infection of a quarter depressed the concentration of potassium and lactose with relative averages of 16,7 and 12,1 % while the sodium concentration increased by 86,4 %.

Infection had no significant influence on fat and protein concentrations.

From the average cell count values obtained in this study, the usually accepted threshold value of 500 000 cells/mm between infected and uninfected cows appeared to be too high. It was determined that the average cell count of cows with one infected quarter was 334 593 cells/mm.

The use of cell counts in the case of mass milk samples in a mastitis control program, has the disadvantage that problem cows cannot be identified. In a small dairy herd one or two cows with high cell counts can be responsible for a high mass tank cell count. Milk from several infected cows in a larger dairy herd can be diluted to such an extent that an acceptable cell count analysis could be obtained from a tank sample.

By means of the determination of the protein concentrations of 169 quarter milk samples with the aid of three different techniques, it was found that the protein concentration of infected milk was 6,8 % higher than that of normal milk. With the present system of fresh milk purchases, producers are paid according to the protein content of their milk. This brings about that producers will be rewarded to some extent for the occurrence of mastitis in their herds.

Results of this study have once again underlined the undesirable effects which mastitis has on milk production and the composition of milk. Unfortunately most producers are unaware of the degree of mastitis infection in their herds. This fact stresses the necessity of a suitable parameter to serve as an indicator of abnormalities in an udder.

Total cell count was the only parameter with discriminant test functions in this study with a reliability level of 1 %. The estimated functions were 74 % accurate with regard to the classification of infected cows. On a 5 % level of reliability the discriminant test functions for lactose were 60 % accurate in the classification of infected cows.

DAIRY CATTLE

PHYSIOLOGY

P.A. de Villiers: MILKING TECHNIQUES AND LACTATION-PHYSIOLOGICAL ASPECTS IN SOUTH AFRICA.
[Research Project (A)VS–Pr.99/1]
Ph.D.: University of the Orange Free State. 1980
Supervisor: Prof. A. Smith

A survey of the incidence of physiological udder disturbances was done with 12 648 milking cows in 160 milk recorded herds in the Transvaal and Free State Regions. This incidence was correlated with the status of milking techniques which occur at the individual herds.

The occurrence of mastitis and damaged quarters varied between 1,7 % and 55,8 % with a mean value of 23,7 %. Approximately 25 % of all udder quarters in an average herd were abnormal and approximately 45 % of the cows were infected. In herds with a high incidence of rough teat surfaces, significantly higher percentages of udder infection occurred.

Milking machine factors such as condition of liner surfaces, short milking tubes, pulsators and

DAIRY CATTLE

variation in vacuum had a significant relationship with udder infection. When the condition of all parts was considered, only five machines were in satisfactory condition.

Regular diagnosis of clinical and subclinical mastitis was not done, or carried out incorrectly in 25 % and 92 % of the herds, respectively.

Hygienic precautionary measures in order to minimise spreading of pathogens, and to ensure production of clean milk, as by udder washing, udder drying, teat dipping and cluster disinfection were implemented correctly in herds in 25 %, 5 %, 18 % and 7 % for these methods, respectively. Teat dipping and cluster disinfection were correlated significantly with udder infection in the survey. The milking machine handling aspects such as stripping and overmilking were also correlated significantly with mastitis.

Dry cow treatment with long action antibiotics was done only in 38 % of the herds.

The number of cows milked and milk produced per man-hour were 13,2 cows and 79,6 ℓ, respectively. At only 27,5 % of the dairy herds the arbitary standard milking time per cow was reached, if the mean milk production was considered.

The mean milk production figures for Friesian and Jersey herds were, respectively, 11,67 ℓ and 9,88 ℓ per day. In Friesian herds milk production was significantly negatively correlated with udder infection.

Management factors such as feeding, herd ration, calf raising, milking intervals, drying off techniques and veterinary treatments in the milking parlour were also studied.

Poor management standards were found at the great majority of herds in the survey.

MUTTON SHEEP

REPRODUCTION

(A)VS-Pr.39/9: EFFECT OF SHORT SCROTUM CASTRATION ON THE GROWTH EFFICIENCY, FERTILITY AND MEAT PRODUCTION OF MERINO-TYPE CROSSBRED LAMBS. 1977-1981

D. Visser

The study was undertaken to compare the growth efficiency and meat production of short scrotum lambs with those of intact rams and wethers and to evaluate the use of short scrotum castrates as teaser rams.

S.A. Mutton Merino x Dohne Merino crossbred ram lambs were divided randomly into a 4 x 3 factorial design with five lambs per cell. The treatments were:

(a) sex of lamb - intact ram *vs* wethers *vs* two types of short scrotum castrates,

(b) live mass at slaughter - 20 *vs* 40 *vs* 60 kg.

Information on growth performance, slaughter characteristics, carcass characteristics, meat characteristics and sex characteristics was collected.

There was no significant difference between the four different sex groups for age at slaughter and average daily gain. The short scrotum 1 type had a better ($P < 0,05$) feed conversion ratio than the other sex types. No difference could be shown for slaughter characteristics except for kidney + kidney fat, for which the wethers were higher ($P < 0,01$) than the two short scrotum types. The only difference in carcass characteristics was that the wethers and short scrotum 1 had a higher ($P < 0,01$) percentage fat in the carcass than the rams and the short scrotum 2. Short scrotum castration had no detrimental effect on the meat quality as evaluated by a taste panel. Mass of testes and epididymi, diameter of seminiferous tubules, and semen quality were adversely affected by short scrotum castration. There was no effect on the accessory glands and libido. The effects of the two types of short scrotums were similar and testis regrowth may occur in both types.

The results on growth performance, slaughter and carcass characteristics were inconclusive. A high coefficient of variation was experienced. It would seem that the short scrotum performs similar to the intact ram. The short scrotum can only be used as a teaser ram if regular semen evaluation is performed to check on testis regrowth.

MUTTON SHEEP

MANAGEMENT

N.314/41/1/1: THREE INTENSIVE FAT-LAMB PRODUCTION SYSTEMS FOR THE HIGH RAINFALL AREAS IN NATAL. 1976-1981

J. Grobbelaar, W.A. Botha, D.A. Sherring, J.D. Smith and S.F. Lesch

S.A. Mutton Merinos were used to compare three intensive fat-lamb production systems.

In the first system ewes were mated 12-monthly, grazed dryland kikuyu pasture during summer and fed maize silage during winter. The second system had the same feeding regime, but the ewes were mated eight-monthly. For the third system the ewes were on pastures the whole year (summer kikuyu and winter irrigated Italian rye grass), and mated at eight-monthly intervals.

Eight-monthly matings under intensive conditions were found to be economically and biologically feasible.

The average margin above feed costs per year for eight-monthly lambing was R19,35 per ewe in comparison to R12,57 for annual lambing. The feed costs per ewe and her lambs were R54,70/a and R44,70, respectively, for eight-monthly *versus* 12-monthly lambing.

The lambing percentage per lambing was lower for the eight-monthly lambing groups (116 % *vs* 135 %), but the annual figure was higher (174 % *vs* 135 %).

Lambs weaned on 70 days and finished on irrigated Italian rye grass had an average daily gain (ADG) of only 155 g in comparison to 221 g when the lambs were supplemented with 700 g of maize per day on rye grass pastures. In the feed lot an ADG of 257 g was obtained.

During the finishing of lambs in a feed lot, part of the concentrate ration can be substituted with maize silage (750 g of concentrate plus 710 g silage instead of 1 100 g concentrate). The lambs grew slower (264 g ADG *vs* 298 g) but total feed costs were less.

Eight-monthly lambing requires a higher managerial input. This probably explains why more farmers do not make use of accelerated lambing systems in spite of the higher financial returns.

MUTTON SHEEP

MANAGEMENT

W-Nt.4: A COMPARISON OF THE GROWTH AND CARCASS PERFORMANCE OF EWES AND CASTRATED AND UNCASTRATED MUTTON MERINO LAMBS ON THE NATURAL PASTURE OF NORTIER EXPERIMENTAL STATION. 1968-1981

The Mutton Merino flock of the Nortier Experimental Station near Lambert's Bay on the west coast was used in an experiment where growth and carcass properties of 213 rams, 202 wethers and 280 ewe lambs were studied.

The ewes were mated for a six-week period starting 1 December and the lambs were marketed in a single batch on a convenient date closest to the middle of October. The experiment was carried out over a period of four years of which one year's results were not included due to a period of drought (67 mm of rainfall) in which the lambs had to be fed. The rainfall figures for the three remaining normal years were: 116 mm, 127 mm and 127 mm. It was postulated that under low rainfall and feeding conditions it would not be necessary to castrate ram lambs if they are to be marketed direct from their mothers.

No significant differences between ram and wether lambs could be demonstrated. Ewe lambs gained slower and produced significantly lighter carcasses. No significant differences with respect to carcass grading and cut out percentages were found among the sexes. These results were reflected in the average market value realised at the Maitland abattoir.

The results led to the conclusion that it is unnecessary to castrate ram lambs when weaners are sold from farms in this particular area.

WOOLLED SHEEP

NUTRITION

OK-Do.64/8: THE WINTERING OF EWES AND LAMBS IN THE SOURVELD OF THE EASTERN CAPE REGION: THE INFLUENCE OF THE QUALITY OF THE VELD AND HIGH PROTEIN SUPPLEMENTS ON THE PRODUCTION OF WET EWES. 1972-1979

H.H. Barnard

In order to develop improved lamb production systems, changes were brought about in the quantity and quality of Dohne Sourveld by veld fertilisation, mowing and sod-seeding of lucerne. The production response of lactating ewes which received high or low protein energy licks on the improved veld, is discussed. Nitrogenous and phosphatic fertilisation increased the dry matter yields ($P < 0,01$) and protein content ($P < 0,05$) of the sourveld. Yield and protein content were also increased by sod-seeding of lucerne into the veld. Mowing the veld did not have a qualitative or quantitative influence. The decline in body mass of the ewes during the winter was less where fertilised, while the lamb growth rate and the wool production were stimulated by fertilisation. There was an interaction between veld quality and type of lick. Wool production was stimulated by the low protein lick while the growth rate of lambs was increased by the high protein lick.

WOOLLED SHEEP

UP-GRADING

K-Gf.72: A COMPARISON OF DIFFERENT SELECTION TECHNIQUES IN MERINO SHEEP. 1962-1981

J.J. Olivier

Three Merino flocks of 200 ewes each were retained from 1962. In two of these flocks, the S and B Groups, various methods of selection for increased clean-wool production were practised. The third group served as the control flock, i.e. Group K.

In Group S rams and ewes with the highest clean-fleece masses were selected, but the wool was not allowed to be stronger than a 60^s spinning count and not more developed than a medium front type. In Group B selection was done by two officials according to the traditional "hand and eye" method, while rams and ewes of Group K were selected at random.

The experiment was carried out from 1962 to 1963 at the Grootfontein College of Agriculture, and from 1964 at the Carnarvon Experimental Farm, which lies in the "Dorre Karoo" and has an annual rainfall of 192 mm. The veld consists mainly of small bushes of which the feeding value varies according to the rainfall. The carrying capacity of the veld is 5 ha/small stock unit.

The birth mass, sex, dam and the type of birth of all lambs that were born were recorded within 24 h of birth. Records were also kept of 120-day mass (corrected for age), six-month mass, 18-month mass, 18-month greasy-fleece mass, clean-fleece mass, percentage clean yield, staple length, crimps per 25 mm and fibre diameter. The masses of ewes at mating and also the annual fleece mass and fleece characteristics were recorded. All the rams, except those used in 1962, 1963 and 1970, were replaced annually by young rams. There was no specific culling age for ewes. Hand-mating was practised.

The results were analysed by means of library programmes for a B6700 computer.

The clean-fleece mass of all three of the selection groups increased from 1962 to 1978, that is from 2,10 kg in 1962 to 2,61 kg in 1978 in Group S, from 2,10 kg in 1962 to 2,50 kg in 1978 in Group B and from 2,20 kg in 1962 to 2,33 kg in 1978 in Group K. The regression equations of clean-fleece mass on years were:

$Y = 2,4351 + 0,0244X$ in Group S,
$Y = 2,3194 + 0,0222X$ in Group B, and
$Y = 2,4015 + 0,0007X$ in Group K

None of these equations deviates significantly from nought. The yearly increase of clean-fleece mass in Group K was the result of a higher rainfall in 1973 to 1977, or natural selection.

The values recorded each year in Groups S and B were expressed as a percentage deviation from the control flock. The results were given independently for rams and ewes. The birth masses of Groups S and

B increased with years but, however, more so in Group S than in Group B. The 18-month masses of Group S rams and ewes decreased with years in comparison with the control flock. During the first years of selection the clean-fleece mass of both Groups S and B rams increased from 12 % below the control to above the control. Thereafter there was only a slight increase in clean-fleece mass. The greasy-fleece mass and the clean-fleece mass of Groups S and B ewes remained constant; however, those of Group S always remained higher. The percentage clean yield of Group S rams increased while those of Group B rams and ewes and Group S ewes remained constant. The staple length of the selection groups remained constant, with that of Group B longer than that of Group S. The crimp frequency decreased slightly in Group S while it remained constant in Groups S and B rams and Group B ewes. The big variation in the different characteristics that appeared from year to year in both selection groups implies that either the populations or the control was unstable.

The deviation from the control in clean-fleece mass of Groups S and B rams could be divided into three phases. There was an increase in the clean-fleece mass in both groups during the first phase (1962-1966), with the regression equation of clean-fleece mass on years of $Y = -0{,}331 + 0{,}137X$ in Group S and $Y = -0{,}299 + 0{,}067X$ in Group B. In the second phase (1967-1972) there was only a slight increase in the clean-fleece mass of Group S rams with the slope of the regression equation only 0,016. The slope of the regression equation of Group B remained approximately the same as in the previous phase, but that was owing to a high value at the end of the phase. In the third phase (1973-1978) there was little response in clean-fleece mass in both the groups. No distinct phases, however, could be identified for ewes, though the clean-fleece mass of Group S was from 0,10 kg to 0,15 kg higher than that of Group B.

The average selection differentials for the rams of Group S were 0,54 ± 0,11 kg and 0,16 ± 0,11 kg for ewes, while they were 0,26 ± 0,13 kg and 0,09 ± 0,07 kg, respectively, for rams and ewes of Group B. Notwithstanding constant selection pressure in both groups, there was only response during the first generation. The selection method used in Group S was 5,84 to 9,40 % more efficient in increasing clean-fleece mass than the method used in Group B. In a better environment this difference may be bigger.

The year of birth had a significant ($P \leqslant 0{,}01$) influence on body mass at birth, 120 days, six months and 18 months and also on 18-month greasy-fleece mass, clean-yield percentage, staple length and fibre thickness. Type of birth/weaning had a significant ($P \leqslant 0{,}01$) influence on birth mass, 120-day mass and six-month mass and also on greasy-fleece mass and clean-fleece mass, while sex had a significant ($P \leqslant 0{,}01$) influence on all measured characteristics except crimp frequency. Maternal age had a significant ($P \leqslant 0{,}05$) influence on birth mass, mass at 120 days, six months and 18 months and also on greasy-fleece mass and clean-fleece mass. The reproductive status of the dam the previous year had no significant influence on any of the characteristics. Some significant ($P \leqslant 0{,}05$) interactions between the various factors occurred, of which those dealing with years were the most important. Correction factors must be applied for type of weaning and maternal age.

At weaning twins were significantly ($P \leqslant 0{,}01$) lighter than singles: 18,553 kg and 20,167 kg, respectively; however, no difference in body mass was found at 18 months. The greasy- and clean-fleece mass of twins were 4,696 kg and 2,494 kg, respectively, which was significantly ($P \leqslant 0{,}01$) lighter than the average greasy-fleece mass of 4,916 kg and the clean-fleece mass of 2,635 kg of singles. This difference apparently was the consequence of pre-natal stress. The mortality of singles (dead at birth or before 24 h) was 16,5 % while that of twins was 20,5 %.

From 1962 to 1978 a total of 9 509 ewes were available for mating. Of these 88 % were served of which 84 % lambed. On an average 114 lambs were born per 100 ewes which lambed. Altogether 14 % of the lambs died before weaning. From the 9 509 ewes available for mating, an average of 70 % lambs were weaned. A lesser number of lambs were weaned in Group S than in either Group B or K.

The percentage of ewes served per ewe mated increased from 66 % in the two-tooth ewes to 98 % in 7,5 year-old ewes. Age had an insignificant effect on the number of ewes lambed per 100 ewes served. The number of lambs weaned per 100 lambs born varied from 80,9 in the two-tooth ewes up to 87,1 in the six-year-old ewes and decreased to 70,8 in the eight-year-old ewes. The number of lambs weaned per 100 ewes mated increased from 44,4 in the two-tooth ewes to 86 in the six-year-old ewes, after which it decreased to 60,7 in the eight-year-old ewes.

To keep the flock number constant, there must be at least four age groups of ewes. If there are five age groups, there will be 8,0 % surplus ewes available annually as opposed to 10 % if six ewe-age groups are maintained. If flock numbers are increased, there will be an annual increase of 5,8 % with five age groups and 7,1 % with six age groups.

The average mating mass of all ewes in all groups was 36,04 kg. The mating mass of ewes that were served but did not lamb, was 35,93 kg in comparison with the 36,16 kg of ewes which gave birth to singles and the 39,52 kg of ewes that gave birth to twins. The average mating mass of ewes that were not served, was 32,44 kg. The mating mass of ewes increased with increased age from 30,02 kg in the two-tooth ewes up to 39,07 kg in the 5,5-year-old ewes. The mass of the ewes that were not served, was significantly smaller than the mass of those served. The mass of the ewes that produced twins, was 9 % greater than the mass of ewes

that produced singles and 10 % greater than the average mass of a specific age group. For successful conception it is not only the mass at mating that is important but also the mass change prior to mating.

The fleece characteristics of the same ewes were significantly ($P \leqslant 0,01$) influenced by the year of measurement, while the age of the ewes had a significant influence only on greasy-fleece mass and clean-fleece mass. The greasy-fleece mass, clean-fleece mass, percentage clean yield, staple length and fibre diameter were significantly ($P \leqslant 0,01$) influenced by the birth type of the ewes.

Some significant interactions, mainly those of years with birth type and age, occurred.

The 3,5-year-old ewes had the highest greasy-fleece masses, clean-fleece masses, percentage clean yields and staple lengths. The greasy-fleece masses, clean-fleece masses, percentage clean yields and staple lengths increased up tc 2,5 to 3,5 years of age. With a further increase of age to 7,5 years, there was only a slight decrease in these characteristics; however, with an increase in age up to 8,5 years, there was a sharp decrease. The crimp frequency and fibre diameter were only slightly influenced by the age of the ewes.

The birth type of the ewes significantly ($P \leqslant 0,01$) influenced the greasy-fleece mass, clean-fleece mass and staple lengths. Ewes that did not lamb, produced on average 5,35 kg greasy wool and 2,90 kg clean wool; however, ewes that lambed and weaned a single produced 4,50 kg greasy wool and 2,37 kg clean wool. Ewes that weaned a twin produced 4,58 kg greasy wool and 2,39 kg clean wool. Pregnancy decreased greasy-fleece mass by 0,64 kg and clean-fleece mass by 0,47 kg, while lactation decreased greasy-fleece mass by 0,13 kg and clean-fleece mass by 0,06 kg. Staple length was significantly decreased (0,49 cm) by pregnancy. The type of birth had no significant influence on percentage clean yield, crimp frequency and fibre diameter.

(The above is an interim report. The facet is to be continued.)

WOOLLED SHEEP

UP-GRADING

OK-Do.88/1: DEVELOPMENT AND IMPROVEMENT OF THE DOHNE MERINO: THE QUANTIFICATION OF BREEDING DATA AND THE CALCULATION OF GENETIC PARAMETERS. 1978-1980

A.J. Fourie

The data for this study were extracted from the development program of the Dohne Merino and were used to compile the flock statistics, to calculate the effect of non-genetic factors and the genetic parameters of this flock. The flock consisted of ± 400 ewes annually and the production data from their progeny for the period 1955 to 1980 were available for this study.

Standard statistical procedures were used to calculate the flock statistics. Age of the ewe influenced the reproduction traits considerably. Reproduction traits between the ages of two and five years increased by approximately 30 % and ewes peaked in these traits at the age of six years. After this age the reproduction traits followed individual patterns but declined in general. From the data the following weaknesses appeared in view of an optimum reproduction potential: low reproduction rate of maiden ewes, a high mortality rate amongst ewes from seven years onwards and the long generation interval for breeding ewes. It was calculated that production and reproduction traits can be genetically optimised with a flock structure of five to six ewe age groups.

The mating mass of the breeding ewes increased rapidly between the ages of 1½ to 4½ years and peaked at the age of 5½ years, with a rapid decline thereafter (Fig. 1). The age of the ewe is a particularly sensitive non-genetic factor in respect of greasy-fleece mass. Greasy-fleece mass increased up to the age of 3½ years and declined rapidly thereafter (Fig. 2). In young ewes staple length and fibre density contributed more to clean-fleece mass than fibre diameter but in older ewes (> 5 years) fibre diameter was the main component of clean-fleece mass and contributed to unkind handling of the wool.

The effect of the non-genetic factors (year of birth, age of the ewe, sex and birth status) on 21 production traits was also investigated. These four environmental factors significantly ($P \leqslant 0,01$) influenced the body mass traits up to 18 months of age whilst the year of birth, birth status and sex significantly ($P \leqslant 0,01$) influenced the 18-month greasy-wool mass. The main influences are summarised in Table 1.

The non-genetic factors were applied as correction factors in the estimation of the genetic parameters by means of the method of halfsib-analysis. The heritabilities of body mass and wool traits are summarised in Table 2.

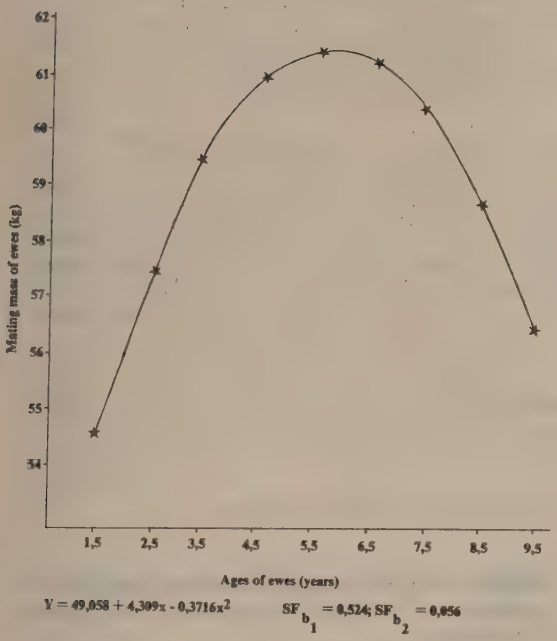

FIG. 1 - Regression of mating mass on age of ewes

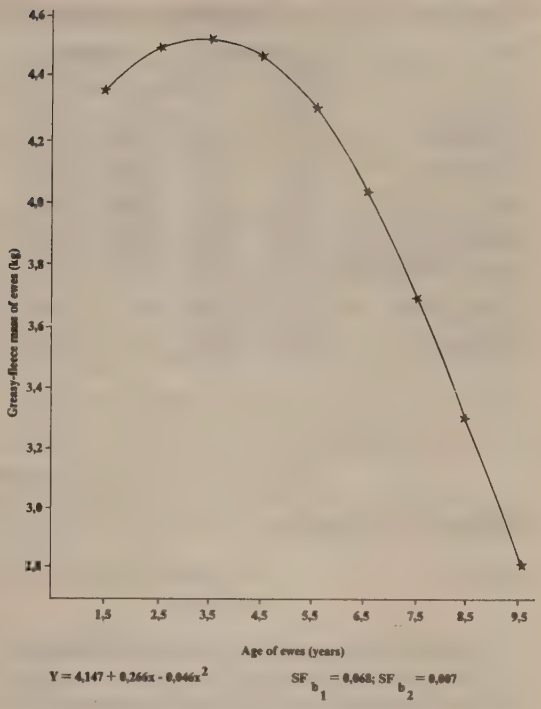

FIG. 2 - Regression of greasy-fleece mass on age of ewes

TABLE 1 - The influence of ewe age, type of birth and sex on five production traits and the estimated correction factors

Environmental factors	Production traits: Birth mass		100-day mass		12-month mass		18-month mass		18-month greasy fleece	
	kg	%	kg	%	kg	%	kg	%	kg	%
Average	**4,52**	**100**	**24,48**	**100**	**49,17**	**100**	**55,44**	**100**	**4,37**	**100**
Ewe age	**		**		**		**			
2 years	-0,32	- 7,07	-0,78	-3,17	-1,27	-2,69	-1,30	- 2,34	-0,14	-3,20
3 years	-0,12	- 2,65	0,18	0,73	0,28	0,59	0,55	0,99	-0,02	-0,45
4 years	0,04	0,88	0,16	0,65	0,05	0,01	0,35	0,63	0,01	0,23
5 years	0,09	1,99	0,39	1,59	-0,47	-0,99	-0,39	- 0,70	0,00	0,00
6 years	0,14	3,09	0,48	1,95	0,19	0,40	0,06	0,11	0,02	0,45
7 years	0,47	10,39	0,11	0,45	-0,21	-0,44	-1,00	- 1,80	-0,06	-1,37
8 years	-0,01	-0,22	-0,29	-1,18	0,38	0,81	0,07	0,11	0,04	0,91
9 years	0,12	2,65	-0,25	-1,02	1,14	2,42	1,67	3,01	0,16	3,66
Type of birth	**		**		**		**		**	
Single	0,49	10,84	1,32	5,37	1,02	2,16	0,96	1,37	0,09	2,06
Twin	-0,49	-10,84	-1,32	-5,37	-1,02	-2,16	-0,96	- 1,37	-0,09	-2,06
Sex	**		**		**		**		**	
Ram	0,13	2,87	0,99	4,03	4,08	8,64	6,12	11,03	0,15	3,43
Ewe	-0,13	- 2,87	-0,99	-4,03	-4,08	-8,64	-6,12	-11,03	-0,15	-3,43

Significant: *P≤ 0,05; **P≤ 0,01

TABLE 2 - Estimations of the heritabilities for 12 production traits in the Dohne Merino for the period 1969 to 1976

Trait	Uncorrected		Corrected	
	h^2	SE	h^2	SE
Birth mass	0,403	0,172	0,208	0,142
42-day mass	0,023	0,110	0,017	0,109
60-day mass	0,321	0,160	0,399	0,171
100-day mass	0,444	0,177	0,390	0,170
120-day mass	0,447	0,178	0,454	0,179
180-day mass	0,433	0,176	0,528	0,189
12-month mass	0,398	0,171	0,365	0,166
18-month mass	0,604	0,198	0,341	0,163
18-month greasy-fleece mass	0,545	0,191	0,292	0,155
Staple length	0,627	0,201	-	-
Fibre diameter	0,595	0,197	-	-
Crimp frequency	0,465	0,191	-	-

OSTRICHES

POTENTIAL STUDY

W-Oh.8/3: OSTRICH SKINS AND LEATHER QUALITY. 1977-1981

D. Swart

Different traits and values of ostriches were investigated with the purpose of defining standards for the ideal slaughter ostrich. The overall slaughter excellence of ostriches is dependent on different characteristics which are impossible to measure on the live animal.

The following criteria were investigated: the area of the skin; the quality and size of the feather buds on the leather; the suppleness and softness of the tanned skins and the mass of the haunches of ostriches at different ages and masses. The economic importance of a feather crop at an age of 14 months was evaluated in relation to the value of the skin and meat at different slaughter ages. Finally, the quality and appearance of the feather buds on the tanned skins were investigated under conditions where slaughter ostriches were marketed with immature or blood feathers.

The particular aim of this study was to use these results to design effective criteria for the selection of slaughter ostriches; i.e. ostriches that would be ready for marketing at a particular time; and breeding ostriches with an overall slaughter excellence. The objective is to systematically improve the average standard of the skin, meat and feathers of the ostrich with a more consistent future in mind.

One hundred and twenty male and female ostriches that were hatched and reared on the Oudtshoorn Experimental Farm, were used as experimental material.

The *modus operandi* was to market various slaughter groups, at different ages and masses. The slaughter groups were selected to minimise maternal effects and genetic differences.

The following traits with regard to the slaughter value of each individual ostrich, were evaluated:

Slaughter age in months

Live mass in kg

Combined mass of the two haunches in kg

Area of the untanned skin in dm^2

Area of the tanned skin in dm^2

Thickness of the tanned skin in mm

Suppleness and softness of the leather

The quality and appearance of the feather buds on the tanned skin, namely the size and shape of the feather buds as well as the number of feather buds

Relationships between measures of slaughter values were analysed by linear and curvilinear regression and correlation techniques. Differences between means ($P \leqslant 0,01$) were tested by the F, t or D statistical test (Snedecor & Cochran, 1969).

An index of the overall excellence of slaughter ostriches was defined in terms of live mass, slaughter age and the physiological growth phase of the body feathers.

The live mass of an ostrich is closely correlated with the skin area ($r^2 = 0,924$). Thus live mass is an effective and useful measure for the determination of skin area of a live bird. According to this, an average skin size of 120 dm^2 can be expected at a live mass of 73 kg, irrespective of the age, diet or management of an ostrich herd.

There is a direct relationship ($b = 0,39$; $r^2 = 0,96$) between the slaughter mass and the mass of the haunches.

Accurate determinations of the live mass are recommended as an indication for skin area and the mass of the haunches. This is of importance in selecting breeding stock and for deciding which birds are immediately suitable for the slaughter market.

In this experimental group of ostriches a definite correlation between age on day of slaughter and carcass mass was determined. Accordingly the variation of age caused 70 % of the variation in carcass mass.

Quilling and plucking of chicken feathers at an age of seven to eight months resulted in a loss of 18 % in skin area and 28 % in haunch mass, when slaughtered at an age of 12 months. Therefore it is uneconomic to market slaughter birds earlier than 14 months of age without a full mature plucking.

The data proved that the ideal size of feather buds on the leather of slaughter birds, is reached between the ages of 14 to 26 months. With regard to the shape and development of the feather buds on tanned skins, it appears that the ideal quality is not reached before an age of 14 months.

In order to ensure softness and suppleness of the leather, it appears that an ostrich should not be slaughtered beyond 20 months of age.

The presence of immature or blood feathers on birds when slaughtered, has a serious negative effect on the shape and appearance of the feather buds on tanned skins. An important observation made was that the skins of birds slaughtered younger than 12 months, even with mature feathers at the time of marketing, resulted in a poor quality and immature feather bud on the tanned skin.

It is concluded that in order to meet the minimum requirements for a first grade skin, the mass of the ostrich should not be smaller than 73 kg and it should not be younger than 14 months when slaughtered.

Animal Products

MILK

CHEMISTRY

(A)VS-Pr.44/1: THE CHEMICAL ASPECT OF MILK PRODUCTION: STUDIES OF THE SYNTHETIC ACTIVITY OF THE MAMMARY GLAND. 1975-1981

H. Lück

The milking of 15 Friesian cows in mid-lactation was discontinued for two weeks, resulting in a change in the composition of the secretion of non-lactating cows. Resumption of milking of two quarters stimulated the synthesis of milk constituents in the other two quarters which were not milked (yielding only small quantities of secretion) and the change in composition in the non-milked quarters was only a trifle slower than that of the two lactating quarters. The following change was observed: the sodium, chloride and non-casein nitrogen content decreased while the potassium, calcium, casein and lactose concentrations increased. The results indicate that composition and yield of the secretion are regulated by different mechanisms.

The study was continued in co-operation with the Veterinary Research Institute, Onderstepoort, to determine the composition of the different whey proteins during and after premature regression.

The concentrations of serum albumin, immunoglobulins, beta-lactoglobulin and alpha-lactalbumin, determined before, during and after premature regression and induced artificially in six healthy Friesian cows, suggest a great functional heterogeneity of the mammary epithelium. After complete cessation of normal milking, the concentrations of the serum and mammary whey proteins showed considerable variations in the rate of increase, times required to reach peak levels and the patterns of their decreasing values, especially when normal milking was resumed on one udder half.

Throughout the investigation the values of serum albumin and immunoglobulin showed a close correlation ($r = 0,78$) which was most pronounced ($r = 0,85$), however, when milking was suspended on both udder halves. From these and other still unpublished data on the production of lactic acid it appears that the presence of serum albumin and immunoglobulin in the regressive mammary secretion may depend on rather similar epithelial systems which favour intramammary conditions with a resultant increase in the production of lactic acid.

MILK

CHEMISTRY

(A)VS-Pr.46/6: THE CHEMICAL/PHYSICAL ASPECTS OF NUTRITION AND CONSUMPTION OF MILK: THE GAS-CHROMATOGRAPHIC METHOD OF DETERMINATION OF AMINO ACIDS IN MILK. 1975-1981
D.J. de Lange and J.A. Nieuwoudt

A study of the quantitative gas-chromatographic analysis of protein amino acids as their N(O)-heptafluorobutyric amino acids, n-propyl and isobutyl esters on single columns with different stationary phases has been made. A single 3,66 m x 3 mm id column with 55 parts of 3% OV-1 on Chromosorb W-HP 80/100 mesh and 45 parts of 3% SP-2100 on Supelcon AW-DMCS 80/100 mesh, was found to be suitable to separate all the amino acid derivatives.

MILK

MICROBIOLOGY

(A)VS-Pr.58/3: THE MICROBIOLOGY OF MILK. 1978-1980
J.F. Mostert

From 169 samples of UHT treated milk, 207 samples of UHT treated desserts and 148 samples of sterilised milk, 220 cultures were isolated; of these 110 were conclusively identified as members of the genus *Bacillus*. The percentage occurrence of these organisms is shown in Table 1.

TABLE 1 - The percentage occurrence of *Bacillus* spp. in UHT treated milk and desserts as well as sterilised milk

Species	% occurrence of *Bacillus* spp.		
	UHT milk	UHT desserts	Sterilised milk
B. cereus	48,6	7,6	21,7
B. licheniformis	13,5	46,1	30,4
B. pumilus	12,1	15,3	17,3
B. subtilus	13,5	30,7	8,6
B. coagulans	5,4	0	0
B. polymyxa	2,7	0	0
B. megatherium	2,7	0	0
B. circulans	1,3	0	4,3
B. stearothermophilus	0	0	13,0
B. alvei	0	0	4,3

The presence and the high incidence of spores from *B. cereus* and *B. subtilus* in these products are associated with insufficient heat treatment of the milk. The high incidence of *B. licheniformis* and *B. pumilus* are remarkable, since these organisms are normally found in high numbers in raw milk supplies. A number of spore formers were found to be resistant to treatment at ultra-high temperatures: e.g. 135 °C for 10 min and 140 °C for 5-10 s. The heat resistance was not species-specific. The occurrence of non-spore-forming organisms from these products indicates that spoilage is frequently due to UHT contamination.

MILK

TECHNOLOGY

(A)VS-Pr.47/1: PERFORMANCE TEST ON AIR ELIMINATORS FOR BULK MILK COLLECTION. 1978-1981
H. Lück

Bulk collection of milk is of very real significance to the farmer and to the dairy industry. The

measurement of milk supplies from farm tanks can, however, be a problem. Because of the difficulty of obtaining an accurate reading from a dipstick in a tank which is out of calibration, the measurement by means of flow meters will be introduced in the future. When milk is pumped from a farm tank through the metering system into the road tanker, an air eliminator must be used to remove any air present in the milk because otherwise the air is measured as milk. The purpose of the study was to test the performance of four different types of air eliminators available in South Africa.

Three sets of tests were carried out on each air eliminator. Set 1 simulated normal conditions of milk collection on the farm (air was only sucked in at the beginning and at the end of the suction process). Sets 2 and 3 simulated conditions where due to loose couplings, air (3-4 % of the flow rate) was sucked into the system during the whole suction process. Air entering the system between pump and air eliminator, consists of relatively large air bubbles (set 2), while air entering the system before the pump causes the air bubbles to become very small (set 3). When air was injected before the pump (set 3), air eliminators types A, B, C and D showed deviations from the volume of the assized tank (500 ℓ) of 1,2; 3,1; 2,8 and 3,5 %, respectively (flow rate 15 000 ℓ/h). Injection of air after the pump (set 2) yielded deviations which were still within the acceptable error limit of ± 0,5 %. With increasing flow rates the performance decreased.

DAIRY PRODUCTS

CHEMISTRY

(A)VS-Pr.65/1: CHLORINATED INSECTICIDE IN DAIRY PRODUCTS. 1972-1981
H. Lück

A survey was conducted to establish the insecticide content of South African dairy products. Some 220 samples (market milk, butter, whole-milk powder and evaporated milk) from different parts of the country were analysed for alpha-, beta-, gamma-BHC, dieldrin/aldrin, DDT, DDE and partly for campheclor. None of the samples exceeded the DDT international maximum residue limit. In 67 % of the samples the total BHC content (mean: 0,27 mg/kg butterfat) and in 32 % of the samples the dieldrin level (mean: 0,13 mg/kg butterfat) exceeded the international maximum residue limits. The results suggest that dieldrin is often misused and that, although BHC was withdrawn in 1970/71, it is still being used. A matter for concern was the high level of camphechlor in some of the dairy products.

DAIRY PRODUCTS

MICROBIOLOGY

(A)VS-Pr.32/8: MICROBIOLOGICAL ASPECTS IN THE STORAGE AND MARKETING OF DAIRY PRODUCTS: STUDY OF THE PROPIONIC ACID BACTERIA IN GOUDA CHEESE. 1972-1981
T.J. Britz

The results of this study showed that the incidence of propionibacterium spp. in South African dairy products was much lower than previously suspected. The results also showed that they occurred most frequently during the winter months and therefore could not be the cause of the late gas production defect in Gouda cheese. Altogether 15 propionibacterium isolates were isolated from South African dairy products by means of a semi-selective growth medium. They could be distinguished on basis of morphological, physiological, biochemical and DNA properties but the species could, however, not be identified by means of conventional identification methods. Using a gaschromatographic method, the rapid detection of propionibacteria is possible and the necessary steps can be taken to prevent gas production defects.

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DAIRY PRODUCTS

MICROBIOLOGY

(A)VS-Pr.53/1: THE HYGIENIC QUALITY OF MILK POWDER. 1978-1981

H. Lück and I. Jordaan

Approximately 100 samples of spray-dried skim milk from ten different factories were tested for undesirable bacteria including toxinogenic, pathogenic or occasionally pathogenic organisms.

No salmonellae per 100 g of powder were found. Only in one sample the presence of *Clostridium perfringens* was confirmed. Thirty per cent of the samples contained *Staphylococcus aureus* per 0,1 g of powder, but in only two of these coagulase-positive staphylococci were found.

DAIRY PRODUCTS

MICROBIOLOGY

(A)VS-Pr.54/4: STUDY OF THE TECHNOLOGY OF STARTER PREPARATION AND PRESERVATION. 1972-1981

W.H. Holzapfel and J.B. Kriel

Pure commercial cultures, one each of *Streptococcus thermophilus* and *Lactobacillus bulgaricus,* were used in this investigation. Seven different substrates (arginine-hydrochloride, asparagine, cystine-hydrochloride, lactose, starch, sodium-glutamate, and 10 % skim-milk solids) were used in freeze-drying and storage experiments. Culture activities were determined in terms of viable counts. Survival rates after freeze-drying only differed slightly for different substrates, and were approximately 10 % of the initial count. Storage at 5 °C resulted in higher survival rates than at 25 °C, and sodium-glutamate and skim milk appeared to be the most efficient substrates for storage of freeze-dried *S. thermophilus* and *L. bulgaricus.*

Subsequent investigations showed that by increasing the skim-milk solids from 10 to 20 % resulted in higher survival rates after freeze-drying, as well as during storage periods of up to 18 weeks. Neutralisation (NaOH) of substrates containing 10 % skim-milk solids had the same beneficial effect as increasing the skim-milk solids to 20 %. A storage temperature of -20 °C resulted in no higher survival rates than one of 5 °C.

DAIRY PRODUCTS

MICROBIOLOGY

(A)VS-Pr.54/7: BACTERIOPHAGE TYPING OF ACID PRODUCING STREPTOCOCCI. 1972-1981

J.B. Kriel

In this investigation use was made of a buffer containing K_2HPO_4 and KH_2PO_4 (3:2) to bind the calcium ions in milk. A medium containing 10 % skim milk powder, 1 % yeast extract and 2 % buffer, was found to inhibit bacteriophage and stimulate starter bacteria. The activity of starter cultures grown in this medium, is significantly higher than that of cultures grown in skim milk. A 30 to 40 % smaller inoculum of a starter grown in this medium, is required for cheesemaking. It has been found that some bacteriophages (e.g. the homologous phage for DRC 1) can lyse host cells in the absence of calcium ions.

This medium, as well as two commercial bacteriophage inhibiting media, did therefore not inhibit this type of bacteriophage. A much cheaper medium can be prepared by omitting the yeast extract. The activity of cultures grown in the buffered milk, is still higher than in the unbuffered milk.

DAIRY PRODUCTS

MICROBIOLOGY

(A)VS-Pr.54/10: MICROBIOLOGICAL ASPECTS IN THE MANUFACTURE OF DAIRY PRODUCTS: THE PREPARATION AND HANDLING OF CHEESE STARTER CULTURES. 1975-1981

J.B. Kriel

In a survey it was clearly established that there is room for improvement concerning the preparation and handling of cheese starter cultures in factories in South Africa.

An uncontaminated active cheese starter is of the greatest importance in the manufacture of cheese. A starter may appear normal to the naked eye but it still may have certain defects. Domination of one starter organism, an imbalance of starter organisms in its composition or a bacteriophage contamination in a mixed starter cannot be readily established. Such a shortcoming will influence the cheese manufacturing process and therefore the quality of the final product. The necessary caution in the preparation of starter cultures is therefore of the utmost importance.

Although Christensen (1972) found that 80 % of cases of inactive cultures were due to bacteriophage contamination, Jesperson (1975) was of the opinion that it is not such a major problem. The position in South Africa as regards this problem will need a thorough investigation.

Publication

KRIEL, J.B. & MOUNTFORD, L.A., 1974. Die bereiding en hantering van moeder- en grootmaatsuurselkulture in Suid-Afrikaanse kaasfabrieke. *S. Afr. Tydskr. Suiweltegnol.* 6, 239-243.

DAIRY PRODUCTS

MICROBIOLOGY

(A)VS-Pr.54/12: MICROBIOLOGICAL ASPECTS IN THE MANUFACTURE OF DAIRY PRODUCTS: PROPIONIC ACID BACTERIA STRAIN SELECTION. 1975-1981

T.J. Britz

Gaschromatographic analyses of the metabolic products of 68 members of the propionibacteria and related coryneforms were carried out in order to determine the feasibility of this technique for differentiating among strains and species of propionibacterium. Among the products detected were acetic, propionic, isobutyric, butyric, isovaleric, valeric, isocaproic and caproic acid. All the propionibacteria produced acetic acid and propionic acid at a ratio of 1:2 and lower. Different fatty acid profiles were obtained for the various species and for strains of the same species. On basis of the fatty acids produced during the fermentation of lactate, the cultures could be divided into five fermentation groups. Compared with conventional identification tests, the gaschromatography procedure is rapid and can be used for sensitive quantitative and qualitative detection of the metabolic products of the propionibacteria.

Publications

BRITZ, T.J. & STEYN, P.L., 1979a. Volatile fatty acid production by the dairy and clinical propionibacteria and related coryneforms. *Phytophylactica* 11, 111-115.

BRITZ, T.J. & STEYN, P.L., 1979b. Cellular fatty acid composition of the clinical and dairy propionibacteria. *S. Afr. J. Dairy Technol.* 11, 3-6.

DAIRY PRODUCTS

MICROBIOLOGY

(A)VS-Pr.55/6: CERTAIN ASPECTS REGARDING THE MANUFACTURE OF MAGOU. 1978-1981
J.B. Kriel

One of the biggest problems experienced by Magou manufacturers, is contamination by yeast, coliforms and other undesirable organisms. Cultures usually become contaminated via the wheat flour or wheat bran which must be added after the heat treatment. By replacing the wheat bran with unsifted wheat flour extract, which has been filter-sterilised, this problem can be solved. The addition of skim-milk powder resulted in an increase in the rate of acid production and made the addition of wheat bran or the extract unnecessary, as it no longer served any additional stimulatory function. Magou with a more pleasant flavour and better consistency was also obtained in this manner. A *Lactobacillus delbreuckii* culture was adapted to grow in Magou by repeated subculturing in a medium with the following composition: 8 % maize meal; 2 % skim-milk powder; 0,1 % K_2HPO_4; 1 % unsifted wheat flour extract and 1 % yeast extract. With each subculture the yeast extract was decreased, until after the seventh subculture the medium no longer contained any.

DAIRY PRODUCTS

MICROBIOLOGY

(A)VS-Pr.59/3: THE CHARACTERISTICS OF AN ANOMALOUS GAS FORMING ORGANISM ISOLATED FROM CHEESE. 1975-1981
J. Walthew

An organism isolated from cheese formed gas in milk and fermented glucose, rhamnose, arabinose, xylose, sorbitol and lactose when it had been grown anaerobically but not when grown aerobically. It hydrolysed gelatin and starch very strongly in either case, and produced catalase. These tests were also carried out on different media to eliminate the possibility of medium influencing the biochemical properties. The media tested were milk, peptone broth, all-purpose medium (APT) in solid and liquid states. It was found that the type of media did not influence the results. Different agar media (tomato, APT, reinforced clostridial, standard methods, nutrient) were tested to see which gave the best results for dilution platings. Nutrient agar was most suitable. Bacteria closely related to the unknown organism, e.g. *Lactobacillus brevis* and *Clostridium acetobytylicum* were used for comparison tests. The unknown bacteria show properties of *Bacillus, Clostridium* and *Lactobacillus* but do not appear to be any of them.

DAIRY PRODUCTS

MICROBIOLOGY

(A)VS-Pr.64/2: KEEPING QUALITY OF DAIRY PRODUCTS. 1978-1981
H. Lück

Bacteriological tests and flavour evaluations were used to determine the shelf life of pasteurised milk (8 samples), cream (4 samples), yoghurt (12 samples) and cottage cheese (6 samples) collected from different factories and stored at 5 to 7 °C. The shelf life (in days) was as follows (the desirable shelf life is given in brackets): pasteurised milk: 5-8 (10), pasteurised cream: 5-8 (10-14, when packed while hot: 21), yoghurt: 4-22 (28), cottage cheese: 8-16 (28). Post-pasteurisation contaminations were responsible for the inadequate shelf life. To reach the desirable shelf life, the following efforts are required: shelf life determinations of all perishable dairy products at the factory, proper sterilisation and control of the post-pasteurisation system and proper management.

DAIRY PRODUCTS

MICROBIOLOGY

(A)VS-Pr.65/2: MYCOTOXINS IN SOUTH AFRICAN DAIRY PRODUCTS. 1978-1981
H. Lück

Seven isolates of *Penicillium roqueforti* and four of *P. camemberti* isolated from Roquefort, Camembert and Brie cheeses available in South Africa, were tested for toxicity. When cultured on maize, all the isolates of *P. roqueforti* were toxic to ducklings, though a considerable degree of variation in toxicity was evident. The toxicity of the isolates of *P. camemberti* was less pronounced than that of *P. roqueforti.*

DAIRY PRODUCTS

TECHNOLOGY

(A)VS-Pr.53/2: THE VIBRATING TUBE METHOD FOR THE DETERMINATION OF THE DENSITY OF CONDENSED MILK. 1978-1981
J.H. Labuschagne

Density measurements using the single vibrating tube principle (Bell & Howell) for the purpose of continuous control of the total solids content of concentrated milk products have been compared with the standard specific gravity bottle, the hydrometer and refractometer methods. The instrument used in these experiments covered the range in density values of between 1 050 to 1 200 kg/m^3. Variations in the relationship of density to the true total solids content were of the same order as those of the control methods. The average standard error of estimate was 0,95 % in terms of the percentage total solids at different levels of concentration of milk, skim milk and whey. The effect of variations in the total solids:fat ratio has been shown and the relationship with density is graphically illustrated.

The single tube instrument is adaptable for a wide range of process media and its accuracy is not impaired by the usual external conditions. It has a low risk of blockage and the usual circulation cleaning and disinfection is effective. The presence of air bubbles in the product has a marked effect on the density measurements which will necessitate the inclusion of an air eliminator in those cases where this occurs. Temperature compensation and automatic reference to a standard temperature are possible, provided the temperature coefficient is known.

WOOL

NORM STUDIES

Ortrud Steinhagen: FOLLICLE AND OTHER PRODUCTION TRAITS OF A DOHNE MERINO FLOCK.
(Research Project OK-Do.6)
M.Sc. (Agric.): University of Stellenbosch. 1979
Supervisor: Prof. P.J. de Wet

This study embraces (i) the influence of the filial generations and flock origin on the wool properties of the Dohne Merino and (ii) the phenotypic correlations between the wool properties. The data were extracted from the original project (OK-Do.6) and based on the results of 320 breeding ewes from the G and M breeding groups.

The filial generations and origin of the flock exerted no significant influence on the wool properties but ewes from the G group were slightly heavier ($P \leqslant 0,05$; Table 1). The phenotypic correlations between the wool properties ranged from non-significant to either highly significant positive or negative associations. In general these phenotypic correlations do not deviate in real extent from the known phenotypic correlations for the Merino. It is, however, noteworthy that body mass exerted fairly strong influences on greasy wool mass, clean wool yield, fibre density and fibre diameter (Table 2). The present

indications are that the follicle ratio and fibre density of the Dohne Merino relate more closely to the S.A. Mutton Merino than to the Merino (Table 3).

TABLE 1 - Influence of filial generations and flock origin on wool traits of the Dohne Merino

		Greasy wool mass	Clean yield	Clean wool mass	Staple length	Fibre diameter	Crimp frequency/ 25 mm	S:P follicle ratio	Fibre density/ cm^2	Body mass
		kg	%	kg	mm					kg
Filial generation	3	3,50	67,1	2,35	81,00	25,60	15,20	14,28:1	2 825*	70,75**
	4	3,26	68,6	2,24	83,52	23,15	13,72	14,00:1	4 128	50,19
	5	3,22	67,8	2,18	82,91	23,03	14,00	13,15:1	3 924	51,70
	6	3.12	69,2	2,17	84,36	22,62	13,72	13,32:1	4 105	50.48
	7	3,32	69,6	2,31	84,24	23,19	13,22	13,56:1	4 048	52,13
	8	3,19	67,6	2,16	84,12	22,54	14,09	14,00:1	4 256	48,92
	9	3,14	67,9	2,14	84,71	22,05	14,39	13,67:1	4 541	49,38
	Av.	3,21	68,7	2,21	83,96	22,85	13,77	13,51:1	4 101	50,95
	Std. dev.	0,42	5,2	0,32	10,79	2,05	1,97	1,71	923,89	6,25
Flock origin	G	3,19	68,3	2,18	83,34	22,79	14,03**	13,56:1	4 098	51,59*
	M	3,23	69,2	2,24	84,76	22,92	13,38	13,44:1	4 106	50,15
	Av.	3,21	68,7	2,21	83,96	22,85	13,77	13,51:1	4 101	50,95
	Std. dev.	0,42	5,2	0,32	10,79	2,05	1,97	1,71	923,89	6,25

Significance
*P<0,05
**P<0,01

TABLE 2 - Phenotypic correlation between wool traits of the Dohne Merino

	Greasy wool mass	Clean yield %	Clean wool mass	Fibre density	S:P follicle ratio	Staple length	Crimp frequency	Fibre diameter	Body mass
Greasy wool mass	1,000								
% clean yield	-0,081	1,000							
Clean wool mass	0,851**	0,442**	1,000						
Fibre density	0,169**	0,007	0,149*	1,000					
S:P follicle ratio	0,128*	0,177**	0,197**	0,147*	1,000				
Staple length	0,152*	0,311**	0,297**	0,142*	0,093	1,000			
Crimp frequency	-0,168**	-0,241**	-0,270**	-0,002	-0,140*	-0,145*	1,000		
Fibre diameter	0,125*	0,044	0,140*	-0,222**	-0,127*	-0,118	-0,206**	1,000	
Body mass	0,291**	0,102	0,320**	-0,192**	-0,005	-0,094	0,035	0,213**	1,000

Significance
*P<0,05
**P<0,01

TABLE 3 - Comparison of follicle ratio and fibre density between breeds

Breed	S:P follicle ratio	Fibre density/ 1 cm^2
Merinos	19,8:1	9 646
Dohne Merinos	12,7:1	6 406
Merino x German Merino (F1)	12,5:1	4 875
South African Mutton Merino	9,7:1	4 385

Supporting Animal Science Research

ANIMAL NUTRITION

PRODUCTION POTENTIAL

OK-Do.64/8: THE WINTERING OF EWES AND LAMBS IN THE SOURVELD OF THE EASTERN CAPE REGION: THE INFLUENCE OF THE QUALITY OF THE VELD AND HIGH PROTEIN SUPPLEMENTS ON THE PRODUCTION OF WET EWES. 1972-1979

W.P. Henning and H.H. Barnard

The availability of sufficient winter cereals during the autumn lambing season is one of the major constraints limiting lamb production in the Dohne Sourveld (Acocks No. 44, 1975). The inherent nutritional limitations of the sourveld is, however, well known. In order to bring about qualitative changes in the sourveld, the veld was either mowed, fertilised or sod-seeded with a legume during the late summer or early autumn of each season. Lucerne was sod-seeded at the rate of 9 kg/ha whilst other camps were fertilised with limestone ammonium nitrate and superphosphate at the rate of 60 kg N and 12,5 kg P/ha. Ewes (Dohne Merino) suckling lambs, were introduced onto this veld at a comparable stocking rate after establishing the initial dry matter yields of the improved swards. In addition the ewes received stimulatory licks during the 1973, 1975 and 1976 seasons with either a high or low protein content (Table 1).

The main findings from this study were:

1. Dry matter yields increased considerably with fertilisation and the sod-seeding of lucerne into the natural sward (Table 3).
2. The major qualitative change in the sward occurred in respect of nitrogen content. Lucerne - constituting 25 % of total dry matter yield only - raised the protein content of the grass component to a level equal to that achieved with 60 kg N and 12,5 kg P/ha. There were no significant qualitative changes in respect of dry matter digestibility (*in vitro*), crude fibre, lignin or cellulose content of the grass (Tables 2 and 3).
3. A general better animal performance was obtained from these improved swards. The growth rate of lambs improved with N fertilisation and was 20 % higher than that on unfertilised veld. The growth rate of lambs on the mowed-fertilised or lucerne-veld sward, was comparable to that achieved with fertilised veld. Similarly, ewes maintained a higher body mass with improved wool yields on these swards (Tables 6 and 7). The improvement in animal response originated, at least partially, from the voluntary intake and selection of a higher quality diet (Table 4).
4. Animals consumed fewer licks on the improved swards (Table 5) and a general better animal response was obtained with a high protein-containing lick on all these pastures. The response to type of lick differed according to parameters used. Maintenance of the ewe and lamb growth responded best to a high protein-containing lick, whilst wool growth responded better to a low protein but high energy-containing lick.
5. These veld improvement techniques and supplementary licks enhance the possibility for the production of lambs off the Dohne Sourveld.

TABLE 1 - Composition of licks

Compound	High protein energy lick	Low protein energy lick	Salt phosphate lick
	%	%	%
Maize meal	-	61	-
Fish meal	40	9	-
Bone meal	10	10	-
Dicalcium phosphate	-	-	45
Salt	40	20	40
Lime	-	-	10
Molasses	-	-	5
Urea	10	-	-
Calculated			
CP	55,2	15,7	
DE (MJ/kg)	5,2	9,5	

TABLE 2 - Effect of nitrogenous fertilisation on the yield and dry matter digestibility of Dohne Sourveld (1976)

	Level of fertilisation (kg N/ha)			
	0	**30**	**60**	**120**
DM yield, kg/ha OD*	2 304	2 842	3 889	3 582
Relative	100	123	169	155
DM digestibility, %**	56,3	55,4	55,8	55,0
Relative	102	101	101	100

*Oven-dry
***In vitro* determination

TABLE 3 - The effect of veld treatments on the qualitative and quantitative aspects of veld grazings

Particulars	**Veld treatments**		
	Saved Effect	**Mowed Effect**	**Lucerne/veld Effect**
1. Yield (oven-dry) (kg/ha)			
1.1 Unfertilised 1973	1 410	1 550	1 685
1.2 Fertilised 1973	2 161	1 826	-
1.3 Unfertilised 1975	2 600	1 955	-
1.4 Fertilised 1975	3 122	2 409	-
2. Crude protein content (%)			
2.1 Unfertilised 1973/75	7,7	7,2	9,8
2.2 Fertilised 1973/75	9,4	10,2	(9,8)
3. Crude fibre content (%)			
3.1 Unfertilised	43,5	45,6	36,0
3.2 Fertilised	43,9	42,0	(36,0)
4. Lignin content (%)			
4.1 Unfertilised	5,8	7,2	8,2
4.2 Fertilised	5,6	6,1	(8,2)
5. Cellulose content (%)			
5.1 Unfertilised	32,1	32,8	27,8
5.2 Fertilised	33,5	31,9	(27,8)

TABLE 4 - Composition of hand-cut and oesophageal fistulated collected samples (1973)

Nutrients		**Veld treatments**								
		Saved			**Mowed**			**Lucerne/veld**		
		Unfertelised	**Fertelised**	**Rel.**	**Unfertelised**	**Fertelised**	**Rel.**	**+ HPL**	**-HPL**	**Rel.**
1. Crude protein	%									
1.1 Hand		7,7	9,4	122	7,2	10,2	142	10,1	9,5	94
1.2 Fistula		9,0	9,9	108	7,8	10,8	138	9,2	10,1	110
	Rel.	117	103		108	106		110	106	
2. Crude fibre	%									
2.1 Hand		43,5	43,9	101	45,6	42,0	92	38,1	37,1	97
2.2 Fistula		45,1	43,5	96	47,0	43,9	93	40,0	42,9	107
	Rel.	104	101		103	104		105	116	
3. Lignin	%									
3.1 Hand		5,8	5,6	97	7,2	6,1	85	8,2	8,0	98
3.2 Fistula		7,5	7,5	100	8,5	8,7	102	9,6	8,5	88
	Rel.	12,9	134		118	163		117	106	
4. Cellulose	%									
4.1 Hand		32,1	33,5	104	32,8	31,9	97	27,5	26,8	97
4.2 Fistula		27,3	31,3	115	32,6	30,3	93	26,7	29,6	111
	Rel.	118	107		101	105		103	110	

TABLE 5 - Lick consumption and nutrient intake of ewes

Particulars		Veld treatments: Saved Unfertilised	Saved Fertilised	Mowed Unfertilised	Mowed Fertilised	Lucerne/veld + HPL	Lucerne/veld -HPL
1. Lick intake	**g/ewe/d**						
1.1 With HPL supplementation	(1973)	92	73	81	66	53	13
1.2 With LPL supplementation	(1975)	341	286	318	261	-	-
1.3 With HPL supplementation	(1976)	102	91	-	-	-	-
1.4 With LPL supplementation	(1976)	175	133	-	-	-	-
2. Crude protein intake	**g/ewe/d**						
2.1 With HPL supplementation	(1973)	51	40	45	36	29	-
2.2 With LPL supplementation	(1975)	54	45	50	41	-	-
2.3 With HPL supplementation	(1976)	56	50	-	-	-	-
2.4 With LPL supplementation	(1976)	27	21	-	-	-	-
3. Energy intake from licks	**MJ/ewe/d**						
3.1 With HPL supplementation	(1973)	0.478	0.380	0.421	0.343	0.276	-
3.2 With LPL supplementation	(1975)	3.240	2.717	3.021	2.480	-	-
3.3 With HPL supplementation	(1976)	0.530	0.473	-	-	-	-
3.4 With LPL supplementation	(1976)	1.663	1.264	-	-	-	-

TABLE 6 - Effect of veld treatments on the production of lactating ewes and lambs (1973, 1975)

Particulars	Veld treatments: Saved +HPL	Saved +LPL	Mowed +HPL	Mowed +LPL	Lucerne/veld +HPL	Lucerne/veld -HPL
1. Loss of mass by ewes (kg)						
1.1 Unfertilised	5.4	5.4	1.4	4.5	3.1	6.5
1.2 Fertilised	2.6	3.9	2.6	4.1	-	-
2. Growth of lambs (g/ℓ/d)						
2.1 Unfertilised	169	106	173	149	192	149
2.2 Fertilised	185	146	179	166	-	-
3. Wool production (clean)	**kg**	**mg/cm²**	**kg**	**mg/cm²**	**kg**	**kg**
3.1 Unfertilised	2.26	12.1	2.24	10.9	2.39	2.23
3.2 Fertilised	2.33	12.9	2.49	13.4	-	-
Significance						
1. Ewe mass	3,26 (5 %) 3,91 (1 %) SA ± 0,785	NS				
2. Wool mass	NS	NS				
3. Lamb growth	39 g (5 %) 47 g (1 %) SA ± 9,39	28 g (5 %) 37 g (1 %) SA ± 4,24				

TABLE 7 - Effect of fertilisation and type of lick supplementation on the production of lactating ewes and lambs (1976)

Particulars	Dohne Sourveld: Fertilised +HPL	Fertilised +LPL	Unfertilised +HPL	Unfertilised +LPL	LSD 5 %	LSD 1 %	SD
1. Ewe							
1.1 Mass (kg)	-0.4	-2.9	0.5	-0.2	1.81	2.42	±0.64
1.2 Wool (kg)	3.59	3.71	3.58	3.82	NS		
2. Lamb growth (g/ℓ/d)							
2.1 2nd week	208	126	245	217			
3rd week	143	143	197	152			
4th week	139	76	191	134			
5th week	108	63	134	108			
Average	150	102	192	153	23.3	31.0	±8.22

ANIMAL NUTRITION

BIOTESTING

OP-NUT.12: THE EFFECT OF SULPHATE IN THE DRINKING WATER OF SHEEP. 1981
J. de V. du Toit, E.L. Barrett and A. von Maltitz

Sheep received drinking water containing sodium sulphate at a level of 1 000 ppm SO_4^{2-} for 3 months. The level was then stepped up to 2 000 ppm for 14 months. Animals slaughtered at this stage had liver and blood copper values of, respectively, 12 % and 15 % lower than those of control sheep. After a further 6 months at a level of 2 500 ppm these values were, respectively, 28 % and 15 % lower than those of control sheep. In addition the mass gain in this group was 11,5 % lower than that of the control group.

It is concluded that as with sodium or zinc sulphate-containing licks, sulphate-containing water will lead to a decrease in blood and liver copper values. It also appears that the abitrarily set maximum level of 2 000 ppm sulphate in drinking water for sheep should not be exceeded.

VETERINARY RESEARCH

Veterinary Science

CATTLE

PATHOLOGY

OP-BACT.65: THE PATHOGENICITY OF *ACTINOBACILLUS SEMINIS* IN CATTLE. 1981
B.C. Jansen

Semen sold by the A.I. organisation Spermova proved to be grossly infected with *Actinobacillus seminis*. The importance of this organism in cattle was, therefore, questioned.

Four two-year-old bulls of which the semen was clean bacteriologically, were anaesthetised and infected with a culture of this organism in the *vas deferens*. The organisms were injected against the flow of the semen in the direction of the *epididymis* about 2 cm from the latter. The bulls were slaughtered after 6 weeks and the *epididymides* were subjected to bacteriological and histopathological examination with completely negative results.

Furthermore, 3 clinically normal heifers were inseminated with semen artificially infected with a culture of *A. seminis*. Two of the heifers conceived on the first insemination and the third one on the second insemination. All three calved normally.

A. seminis does not appear to be pathogenic for cattle.

CATTLE

PATHOLOGY

OP-PATH.41: INVESTIGATIONS ON THE NATURAL AND ACQUIRED RESISTANCE OF CATTLE TO ARTIFICIAL INFECTION WITH *COWDRIA RUMINANTIUM*. 1979
J.L. du Plessis and J.D. Bezuidenhout

Sixty cattle, artificially immunised against *C. ruminantium* were challenged 3, 6, 12 and 24 months later. Levels of conglutinin were determined in pre-immunisation serum samples. There appeared to be a relationship between the pre-infection levels of conglutinin and the susceptibility of the animals to heartwater. At the time of immunisation 31 out of 60 cattle (51,6 %) with levels in the low-titre range (1:101:160) showed a typical febrile response, whereas 29 (48,4 %) with conglutinin levels in the high-titre range (1:320 and higher) were either fully or partially resistant.

CATTLE

Except for 2 animals that developed mild febrile reactions when they were challenged 2 years after artificial immunisation, all the cattle were fully resistant to challenge with *C. ruminantium* infected sheep blood. It can be concluded that in this experiment cattle retained their immunity to heartwater for at least 2 years in the absence of reinfection.

CATTLE

PESTS

OP-ENT.18: THE DISTRIBUTION OF BLUE TICKS IN SOUTH AFRICA.
1981
A.M. Spickett and H. Heyne

The blue ticks represent 2 species, *Boophilus decoloratus* and *B. microplus,* which are both responsible for the transmission of redwater to cattle. The project was started on evidence that *B. microplus* seemed to oust *B. decoloratus* in certain areas and occur more widely distributed than hitherto recorded.

Results of the survey:

(a) confirmed previous records for both species,
(b) confirmed that *B. microplus* had spread in certain areas in Natal,
(c) revealed the spread of *B. microplus* in the Transvaal, east from Pretoria to Nelspruit, where it would not be expected to occur, and
(d) revealed the spread of *B. decoloratus* into the northern Cape, concurrent with times of heavy rainfall, as far west as Kimberley and Barkley West where cattle under normal conditions do not experience this tick or the disease condition.

Distribution of both species in South Africa are as follows:

B. decoloratus

B. decoloratus is present almost throughout the Transvaal, though it is relatively rare in the eastern lowveld, and all through Swaziland, Natal and the northern and eastern parts of the Orange Free State (OFS). It also extends into Lesotho, though its precise distribution there has not been established. In the western and southern sectors of the OFS, however, it only occurs sporadically. In the Cape Province it is found throughout the Eastern Province, the coastal belt and the winter rainfall areas, also in those parts of the north-eastern corner of the Cape (Mafikeng, Vryburg, Taung and the northern part of Barkly West) where the annual rainfall averages over 380 mm. It is absent from the central Karoo, Bushmanland and Little Namaqualand.

The distribution of this species is limited by decreasing humidity and in general it is absent from areas with an average annual rainfall of less than about 380 mm. Sometimes, however, it can survive in areas of lower rainfall if the dryness is moderated by other environmental factors. At times also, it may be introduced into a new area during a season when the rainfall is higher than average, resulting in good vegetation cover, and may then be able to maintain itself for a while before it dies out again. Although its numbers and activity may be somewhat reduced by cold it appears to be well established in some areas on the highveld with up to 120 frosty days in winter.

B. microplus

B. microplus occurs in the Transvaal to the north and east of Pretoria and in the Witbank, Belfast, White River, Carolina, Barberton, Ermelo and Wakkerstroom districts. In Natal it has been found in the north, in the Newcastle, Hlabisa, Lower Umfolozi and Mtunzini districts and in the south in the Camperdown, Ixopo, Umzinto, Port Shepstone and Port Alfred districts. It also occurs in the Umzimkulu, Bizana, Flagstaff, Lusikisiki, Tsolo, Libode, Ngqeleni and Elliotdale districts in the Transkei. In the Cape Province it is present in isolated pockets along the southern coast in the districts of Humansdorp, Knysna, George, Mossel Bay, Heidelberg, Swellendam, Caledon and Robertson.

There is little doubt that it is more widely distributed than present records indicate.

In the field it is generally most prevalent in the milder coastal areas, however, it is apparently also well established in some inland areas experiencing up to 60 days of frost during the winter. It can only be assumed that in these areas there are localised microclimatic conditions enabling it to exist.

Continued monitoring of these 2 species is effected through examination of specimens submitted for routine identification.

CATTLE

PROTOZOOLOGY

OP-PROT.18: ISOLATION AND TRANSMISSION OF AN UNIDENTIFIED *BABESIA* SP. INFECTIVE FOR CATTLE. 1981

Shan E. Thomas and T.E. Mason

Engorged adult female ticks submitted from farms in South Africa were examined for protozoan parasites. An unidentified *Babesia* sp. was found in *Hyalomma marginatum rufipes*. Transmission of the parasites to susceptible cattle was achieved both biologically (tick feeding) and mechanically (injection of infected blood). Attempts to transmit this species to susceptible rabbits and a horse using similar methods, did not result in detectable parasitaemias.

This parasite was of low pathogenicity, even in splenectomised cattle. Morphologically intra-erythrocytic piroplasms and merozoites in tick haemolymph resembled other bovine *Babesia* spp. in many respects. In size, this *Babesia* was intermediate between the other species.

Publication

THOMAS, S.E. & MASON, T.E., 1981. Isolation and transmission of an unidentified *Babesia* sp. infective for cattle. *Onderstepoort J. vet. Res.* (In press.)

CATTLE

VIROLOGY

OP-PATH.44: STUDIES ON NEONATAL CALF DIARRHOEA CAUSED BY ROTAVIRUS: TRANSMISSION OF THE DISEASE AND ATTEMPTED VACCINATION OF COLOSTRUM-DEPRIVED CALVES. 1980

A. Theodoridis, L. Prozesky and H.J. Els

Mild to severe scouring could be produced in colostrum-deprived calves with tissue culture-adapted rotavirus and faecal material from field cases of calf diarrhoea. The faeces of experimentally infected calves contained rotavirus for at least 3 days. Pathogenic bacteria were present in one calf only and this calf also showed the most severe gastroenteritis.

Eight calves were vaccinated with a live rotaviral calf diarrhoea vaccine and subsequently challenged with infective rotavirus. Mild scouring was observed after vaccination, but the calves remained normal after challenge. Rotavirus particles were detectable in the faeces for a few days after vaccination and challenge.

CATTLE

VIROLOGY

OP-MOL.45: THE INFLUENCE OF SERUM-CONGLUTININ LEVELS ON THE SUSCEPTIBILITY OF 2-6-MONTH-OLD CALVES TO HEARTWATER. 1981

J.L. du Plessis

It is suggested that the natural resistance of calves to *Cowdria ruminantium* is not limited to the first 4 weeks of their lives, as has hitherto been accepted, but that it lasts much longer and even as long as 5 months in some cases. The question arises whether the resistance of young calves can be distinguished from that usually shown by 20-40 % adult cattle infected with the heartwater agent. It has been suggested that high levels of conglutinin in the serum of the latter play a role in their resistance. Should the resistance of young calves be different from that of adult cattle, the results in this experiment do not necessarily rule out the conglutinin theory altogether. High levels of serum conglutinin in case of the 6 calves that developed severe reactions or that died when they were infected would, on the other hand, have seriously questioned the validity of the conglutin theory.

SHEEP

PATHOLOGY

OP-DMR.36: CHANGES IN LACTATE-PRODUCING AND LACTATE-UTILISING BACTERIA IN RELATION TO pH IN THE RUMEN OF SHEEP DURING STEPWISE ADAPTATION TO A HIGH-CONCENTRATE DIET. 1979

R.I. Mackie and Frances M.C. Gilchrist

Changes in the numbers and types of lactate-producing and lactate-utilising bacteria in the rumen of sheep were followed during stepwise adaptation from a low- to a high-concentrate diet. The mean numbers of bacteria increased after each change in diet when increasing amounts of maize grain were substituted for maize stover. A surge in number of amylolytic bacteria always preceded an increase in lactate-utilising bacteria, and with the final diet containing 71 % grain and molasses the two groups tended to balance each other, which resulted in low lactic acid accumulation. The lactate utilisers thus played a key role in controlling the fermentation. Orderly shifts occurred among the predominating amylolytic and lactate-utilising bacteria in response to the gradual decrease in ruminal pH as the amount of maize meal in the diet increased. Among the lactate utilisers, the succession began with acid-sensitive *Veillonella* and *Selenomonas,* which were superseded by more acid-tolerant *Anaerovibrio* and *Propionibacterium.* Among the amylolytic bacteria, *Bacteroides* was superseded by more acid-tolerant *Lactobacillus* and *Eubacterium.* The ecological succession of predominating genera was shown to be correlated significantly with ruminal pH and, more specifically, with the length of time as well as the extent to which the pH remained below a certain critical undefined value in the rumen, arbitrarily set at pH 6,00.

Publication

MACKIE, R.I. & GILCHRIST, F.M.C., 1979. Changes in lactate-producing and lactate-utilising bacteria in relation to pH in the rumen of sheep during stepwise adaptation to a high-concentrate diet. *Applied Envir. Microbiol.* 38, 422-430.

SHEEP

PATHOLOGY

OP-DMR.52: ENUMERATION AND ISOLATION OF LACTATE-UTILISING BACTERIA FROM THE RUMEN OF SHEEP. 1979

R.I. Mackie and Suzette Heath

A highly specific medium was developed for the enumeration of lactate-utilising bacteria in the rumen of sheep. This medium, which contained 2,0 % lactate, 2,0 % trypticase, 0,2 % yeast extract, and volatile fatty acids, hemin, and trace elements in place of rumen fluid, enabled high counts (42 x 10^7 to 190 x 10^7/g of ingesta) of lactate-utilising bacteria to be made with a high degree of specificity (96 %). The medium also supported the growth of all species of predominant lactate-utilising bacteria reported to occur in the rumen and thus is of importance for ecological studies where the incidence and influence of the different species on lactate metabolism under changing conditions in the rumen cannot be predicted. The survival rate of isolates was increased from 60 to 96 % by addition to the modified maintenance medium of 40 % rumen fluid in place of the volatile fatty acids, hemin, and trace elements used in the counting medium. These results, together with the slow growth of colonies in roll bottles, showed that, although highly selective, the counting medium was not optimal for the types selected.

Publication

MACKIE, R.I. & HEATH, S., 1979. Enumeration and isolation of lactate-utilising bacteria from the rumen of sheep. *Applied Envir. Microbiol.* 38, 416-421.

SHEEP

PATHOLOGY

OP-BACT.64: PATHOLOGY OF BACTERIAL INFECTION OF THE GENITALIA IN RAMS. 1980
B.C. Jansen

Details are given of the macroscopic and histopathological changes brought about by infection of the genitalia of rams by bacteria other than *Brucella ovis*. Lesions of the vesiculae seminales and ampullae are described which, in addition to the clinically evident lesions of the testes and epididymides, could be an important reason for impaired fertility.

The name "bacterial infection of the genitalia", abbreviated to BIG, is suggested as a more appropriate designation for this condition than "ram epididymitis".

Publication

JANSEN, E.C., 1980. Pathology of bacterial infection of the genitalia in rams. *Onderstepoort J. vet. Res.* 47, 263-267.

SHEEP

PATHOLOGY

OP-MOL.44: THE INFLUENCE OF DITHIOSEMICARBAZONE ON THE IMMUNITY OF SHEEP TO HEARTWATER. 1981
J.L. du Plessis

Four out of 9 sheep, immune to heartwater and subsequently treated with dithiosemicarbazone, showed a febrile reaction when they were challenged 6 months later, but the same number of untreated controls also reacted. In a second group of treated immune animals challenged after 9 months, 8 out of 8 showed a febrile reaction, whereas only 3 out of 8 controls reacted. Furthermore, the blood of one of the 4 sheep that reacted to challenge at 6 months was infective to a susceptible sheep inoculated with it, whereas that of 4 out of the 8 challenged at 9 months was infective.

Publication

DU PLESSIS, J.L., 1981. The influence of dithiosemicarbazone on the immunity of sheep to heartwater. *Onderstepoort J. vet. Res.* (In press.)

SHEEP

PATHOLOGY

OP-PATH.50: PARALYSIS IN LAMBS CAUSED BY OVERDOSING WITH PARBENDAZOLE. 1981
L. Prozesky, J.P.J. Joubert and M.D. Ekron

An experiment was undertaken to determine whether an overdose of parbendazole could cause paralysis in lambs when given to ewes during the early stages of pregnancy. Out of a total of 68 lambs, born from ewes treated with parbendazole at 180 mg/kg at various stages of gestation, 5 showed the paralysis syndrome, 5 showed skeletal deformities, 2 were ataxic, while 1 foetus was aborted. The ewes giving birth to paralysed lambs had been treated with parbendazole at 30, 32, 37 and 53 days of gestation. Cerebral hypoplasia was observed in 2 of these lambs, while 2 others showed internal hydrocephaly. Histopathological lesions observed in the lambs with cerebral hypoplasia included gliosis and areas of encephalomalacia in the cerebral white matter. Lesions present in the spinal cords of the 2 ataxic lambs included hydromyelia, syringomyelia, duplication of the spinal canal and an abnormal position of the canal. This is the first report describing brain lesions in lambs as a result of an overdose of parbendazole.

SHEEP

PESTS

OP-ENT.28: THE EFFECT OF ^{60}CO IRRADIATION ON GAMETOGENISIS OF *AMBLYOMMA HEBRAEUM*. 1981.
A.M. Spickett, J.D. Bezuidenhout and Catharina J. Jacobz

An attempt was made to attenuate *C. ruminantium* by irradiation of the nymphal stage of its tick host. The nymphae were homogenised and serial dilutions of the resultant suspension injected intravenously into heartwater susceptible sheep. No attenuation could be demonstrated but the results indicate that progressively more micro-organisms are destroyed the higher the irradiation dosage applied, with between 20 and 30 kilorad proving fatal to all the pathogenic organisms.

SHEEP

TOXICOLOGY

OP-TOX.2: ELECTROCARDIOGRAPHIC CHANGES ENCOUNTERED IN SHEEP WITH *HOMERIA GLAUCA* (W. & E.) N.E. BR., 1,2-EPOXYSCILLIROSIDIN AND DIGOXIN INTOXICATION. 1981
T.W. Naudé and P.J. Pretorius

A comparative study was made of the electrocardiographic (ECG) and other changes encountered in sheep after oral administration of dried plant material of *Homeria glauca,* intravenous administration of the bufadienolide aglycone 1,2-epoxyscillirosidin (the main toxic principle of *H. glauca*) and the intravenous administration of the cardenolide glycoside digoxin.

In contrast to what is described for cardiac glycosides in man, inversion of the T wave and depression of the ST segment were only erratically encountered in the sheep. Prolongation of the PR interval was marked in only one out of 3 sheep that had received digoxin. With *H. glauca* and epoxyscillirosidin, on the contrary, a tendency to a decrease in the PR time was noted.

In the terminal experiments disturbance in AV conduction was the most constant and dramatic change encountered in all 3 groups. With the two bufadienolide groups sinus tachycardia was followed by runs of ventricular tachycardia of AV nodal origin. Multifocal ectopic ventricular impulses then occurred and increased in frequency and resulted in severe arrhythmia. Runs of normal sinus rhythm were encountered intermittently. The paroxysmal nature of these changes was very characteristic. With digoxin administered intravenously, ectopic coupled rhythm appeared almost directly after administration and this was followed by the same changes as in the other two groups.

The absence of ECG changes at low dosages in the non-terminal experiments where clinical signs like ruminal stasis, slight ataxia, exaggerated respiratory movements and abdominal breathing were clearly in evidence, was contrary to expectations.

In the terminal experiments such extra-cardiac effects were very pronounced and severe respiratory involvement in the form of attacks of dyspnoea which seemed to be independent of cardiac crises occurred and resulted in death in some instances. In addition, pronounced paresis and even paralysis were present.

SHEEP

VIROLOGY

OP-PATH.39: CLINICAL AND PATHOLOGICAL STUDIES IN ADULT SHEEP AND GOATS EXPERIMENTALLY INFECTED WITH WESSELSBRON DISEASE VIRUS. 1981
J.A.W. Coetzer and A. Theodoridis

The clinical symptoms and pathology in 33 adult sheep and 31 adult goats experimentally infected with Wesselsbron disease virus are described. There was moderate to severe hyperthermia in most animals but no other clinical signs of disease or deaths were recorded.

SHEEP

Eleven sheep and 6 goats were sacrificed for pathological studies at various stages during the febrile response. The macroscopic and microscopic lesions in these cases are described. Microscopic studies revealed that the liver was consistently affected and showed small foci of necrosis. These were sparsely distributed and associated with a marked localised Kupffer cell response ("retothelial nodules"). In addition, acidophilic bodies and small groups of necrotic hepatocytes were evident in some lobules. Apart from the hepatic lesions, mild to moderate pyknosis and karyorrhexis of lymphocytes were seen in the spleen and lymph nodes.

This report also compares the microscopic lesions in the livers of adult sheep and goats with those of newborn lambs for Wesselsbron disease as well as with those reported for Rift Valley fever in adult sheep.

SHEEP

VIROLOGY

OP-PATH.51: SEQUENTIAL DEVELOPMENT OF THE LIVER LESIONS IN NEWBORN LAMBS INFECTED WITH RIFT VALLEY FEVER VIRUS. 1981

J.A.W. Coetzer, K.G. Ishak and R.D. Calvert

1. Macroscopic and microscopic findings

Ten newborn lambs were infected subcutaneously with Rift Valley fever virus in order to study the sequential development of the hepatic lesions. Starting 6 h after inoculation, and then every 6 h thereafter until 48 h, one lamb was killed for necropsy at each interval. Three lambs were *in extremis* 51-53 h post inoculation and were necropsied to study the terminal stage of the hepatic lesions.

During the late stage of the disease, the livers were slightly to moderately swollen and mottled yellow, orange-brown and red. Greyish-white foci, approximately 0,25-0,5 mm in diameter, were also scattered throughout.

Microscopically, the liver lesions progressed from sparsely distributed acidophilic bodies and hepatocytes revealing acidophilic degeneration and necrosis 6-12 h post inoculation, to small randomly scattered "primary foci" of necrosis 12-24 h after infection. At 30-36 h, these "primary foci" were larger and more circumscribed. In addition, numerous acidophilic bodies and necrotic hepatocytes were dispersed throughout the markedly degenerated parenchyma. The terminal stage of the disease (48-53 h after inoculation), was characterised by massive hepatic necrosis in which "primary foci" of necrosis could still be recognised as a dense aggregation of cytoplasmic and nuclear debris.

2. Ultrastructural findings

The macroscopic and microscopic lesions in livers of newborn lambs experimentally infected with Rift Valley fever (RVF) virus and killed at various intervals between 6-53 h after inoculation were described in a preceding paper. This communication gives an overview of the ultrastructural changes affecting hepatocytes, sinusoids and spaces of Disse, biliary tree and portal triads as well as observations on the morphology and morphogenesis of the virus.

Hepatocytes were primarily affected, while inflammatory and architectural changes were secondary. The changes included prominent nuclear alterations, fragmentation or disintegration of necrotic hepatocytes, focal cytoplasmic degradation and sequestration, and the presence of acidophilic bodies. The ultrastructure and origin of the intranuclear inclusions are discussed.

PIGS

VIROLOGY

OP-PATH.37: LESIONS RESULTING FROM INOCULATION OF PORCINE FOETUSES WITH PORCINE PARVOVIRUS. 1980

L. Prozesky, G.R. Thomson, M.D. Gainaru, S. Herr and L.J. Kritzinger

In utero inoculation of 15 sows at various stages of gestation with a local strain of porcine parvovirus (PPV) resulted in resorption, abortion or the birth of weak, dead, or mummified foetuses.

Histopathological lesions observed in foetuses of sows slaughtered at various post-inoculation intervals consisted of a perivascular inflammatory reaction primarily observed in the brain and kidneys. The presence and extent of the inflammatory reaction were dependent upon the age of the foetus at the time of infection. In the sow a perivascular inflammatory reaction was found in the endometrium, while the larger blood vessel walls were infiltrated by lymphocytes, and it is suggested that these vascular lesions may contribute to the reproductive failures associated with PPV.

PIGS

VIROLOGY

OP-VIR.48: CAUSES OF ABORTION AND FERTILITY IN PIGS. 1981

G.R. Thomson, C.J.V. Trichard, M.M. Henton, L. Prozesky, B. McIntosh and B.T. Spencer

Basically between 10 and 20 identified sows and gilts on 10 farms were bled monthly to enable serological testing against known pathogens which influence reproduction in swine. In addition vaginal swabs were taken from the sows and gilts at the time of bleeding. It was hoped that the results of these samplings would be useful in assessing problems on the test farms when they occurred since half of the farms were selected on the basis of experiencing continual problems with reproduction in pigs.

Unfortunately during the sampling period only one farm experienced problems of a nature which was of interest and this farmer failed to report the problems until several months after the event.

The pathogens tested for serologically were: brucellosis, leptospirosis, porcine parvovirus (PPV), Aujeszky's disease, haemagglutinating encephalomyelitis virus and a number of arboviruses. However, only tests for PPV and arboviruses proved positive. In the latter case precise identification of the viruses involved is difficult because only haemagglutination inhibition tests were possible (i.e., only group activity could be identified).

Evidence from diagnostic material received between 1977 and 1980 indicated that of the above agents only PPV was important. In fact a number of economically serious outbreaks of the disease were investigated during this period. This information, however, is difficult to reconcile with the results of this serological survey. The reason for this is that even on farms where the herd immunity was low (20% of serologically positive animals) serological evidence for active infection with this virus was obtained without concomitant disease. Thus we were unable to define under what circumstances this common infection becomes pathogenic.

PIGS

VIROLOGY

OP-VIR.53: THE DEVELOPMENT OF AN INACTIVATED PORCINE PARVOVIRUS VACCINE FOR USE IN SOWS AND GILTS. 1981

G.R. Thomson, M.D. Gainaru and B.T. Spencer

The main findings can be summarised as follows:

1. High concentration of formalin (4% at 4 °C for 48 h) was required to completely inactivate the virus. Such treatment resulted in an eightfold decrease in haemagglutination activity of antigen preparations.
2. Formalin inactivated antigen mixed with 25% alhydrogel was used to inoculate two groups of serologically negative pigs. Unfortunately, the second group contracted the infection during the course of the investigation and therefore could not be used. The first group showed that only antigen diluted $^{1}/_{5}$ was effective in eliciting an antibody response in pigs and that only antigen used undiluted produced high antibody levels (i.e. $^{1}/_{1280}$ following the secondary stimulus).

These results indicate that inactivated porcine parvovirus vaccines are possible. However, the low potency indicates that vaccines produced in this way would be relatively expensive.

HORSES

PATHOLOGY

OP-BACT.46: THE IMMUNE RESPONSE OF HORSES TO TETANUS TOXOID. 1979
B.C. Jansen and P.C. Knoetze

An intramuscular injection of 8-16 Lf tetanus toxoid in water-in-oil emulsion protected adult horses against tetanus for at least 128 weeks. A booster dose of 8 Lf toxoid in aqueous solution protected them for a further period of at least 3½ years.

Colostral immunity protected foals for at least 10 weeks. An intramuscular injection of 8 Lf toxoid in water-in-oil emulsion given to foals from immune dams when they were 10-18 weeks old did not elicit any antibody response. They did respond, however, to a booster injection of 8 Lf toxoid in aqueous solution given 12 weeks after the first dose.

New-born foals were shown to be inherently unable to respond to an injection of tetanus toxoid.

Publication

JANSEN, B.C. & KNOETZE, P.C., 1979. The immune response of horses to tetanus toxoid. *Onderstepoort J. vet. Res.* 46, 211-216.

POULTRY

PATHOLOGY

OP-POUL.22: THE INFLUENCE OF FURAZOLIDONE AT VARIOUS CONCENTRATIONS IN THE RATION ON BROILERS. 1981
S.P. Greyling

Furazolidone is advocated at levels between 200 and 400 g/t of feed for the treatment of infections by gram negative bacilli, especially *E. coli* and salmonellosis, in chickens. To determine its effect at higher levels it was fed at concentrations of 400 g, 600 g and 800 g per 1 000 kg of the ration, to normal healthy broilers from day old to 8 weeks old. At the higher two levels the drug caused congestive cardiac failure in the chickens with associated symptoms. Histopathological examination revealed a focal disseminated, acute myocarditis and a mild to severe fibrosis of the myocard, cyanotic induration of the liver, bile duct proliferation and necrosis of the bile duct epithelium. At the higher two concentrations in the ration, the drug also had an inhibiting effect on the growth of the broilers.

LABORATORY ANIMALS

PATHOLOGY

OP-BACT.41: PATHOGENESIS AND IMMUNITY TO *ACTINOBACILLUS SEMINIS*. 1981
C.M. Cameron, Aletta S.M. Vermeulen and F. Schutte

Extensive experiments were undertaken to establish an experimental model for the study of *A. seminis* immunity. Mice, guinea-pigs, rabbits and hamsters were infected with cultures of five different strains by a variety of routes but no lesions could be established. The use of gastric mucin and Indian ink also did not enhance the pathogenicity of the strains for laboratory animals.

Sheep succumbed to intravenous infection and orchitis was established when injections were made directly into the testis but infection could not be established by any other route. Attempts to establish an allergic orchitis also failed.

Guinea-pigs that were immunised with an experimental oil emulsion vaccine developed high complement fixing serum antibody titres, exhibited skin sensitivity and showed macrophage migration inhibition. Since they could not be challenged, their immune status could not be determined.

LABORATORY ANIMALS

PATHOLOGY

OP-PATH.11: MICE INFECTED WITH A *COWDRIA RUMINANTIUM*-LIKE AGENT AS A MODEL IN THE STUDY OF HEARTWATER. 1981
J.L. du Plessis

A rickettsia-like micro-organism, morphologically resembling *Cowdria ruminantium,* the causal agent of heartwater, was originally isolated from a goat. It was subsequently established in mice and is referred to in this study as the mouse agent. The brain of a sheep and the peritoneal macrophages of mice infected with the mouse agent were used to prepare antigens for the complement fixation and indirect fluorescent antibody tests respectively. These tests showed that the mouse agent is immunologically distinct from other rickettsia-like agents, but closely related to the Ball 3 strain of *C. ruminantium.* The marked pathogenicity of the agent to mice and sheep, in contrast to its mild pathogenicity in cattle, indicates, however, that it is probably a strain of the heartwater agent distinct from the Ball 3 strain.

Passage of the agent in mice does not change its pathogenicity to mice, sheep and cattle. Sheep that have recovered from infection with the agent are only partially immune to challenge with the Ball 3 strain; cattle that have been infected with the agent are fully susceptible to the Ball 3 strain.

The mouse agent can be biologically transmitted to susceptible sheep by the 3-host tick, *Amblyomma hebraeum,* the arthropod vector of heartwater. Infection in ticks is carried transstadially, but not transovarially, the agent maintaining its infectivity to mice and sheep both in the nymphal and the adult stages.

The immunity of mice that have recovered from infection with the agent is characterised by resistance to reinfection for at least 18 months, participation by cellular rather than humoral elements of the immune apparatus and persistence of the causal agent in the tissues of immune mice during almost the entire period of their resistance.

According to electron microscopic as well as other observations, the mouse agent appears to have a biphasic developmental cycle in the mammalian host. The primary stage occurs in reticulo-endothelial cells, in which replication of the agent differs from that in the secondary stage in vascular endothelial cells, where it divides by binary fission. In view of this developmental cycle, involving two cell types, a reconsideration of the taxonomic position of *C. ruminantium* is recommended.

The benefits that can be derived from mice infected with the mouse agent are twofold. Not only could they serve as a model in the study of heartwater, but they also provide a source of antigen for the indirect fluorescent antibody test. In the present study, mice have already served as a model with which additional knowledge on the mechanism of the immunity in heartwater on the one hand, and the developmental cycle of the heartwater agent in the mammalian host on the other, was gained. It holds good promise, though, as a model to study other poorly known aspects of the disease, such as its pathogenesis and the cycle of the agent in the arthropod host. The availability of an antigen for the fluorescent antibody test is important for further studies on the epidemiology of heartwater, better knowledge of which is essential for the prevention and control of the disease.

LABORATORY ANIMALS

PATHOLOGY

OP-PATH.35: A PRELIMINARY ATTEMPT TO ESTABLISH AN INBRED LINE OF MICE RESISTANT TO RICKETTSIA-LIKE ORGANISM. 1981
J.L. du Plessis

An attempt to establish an inbred line of mice resistant to the mouse strain of *Cowdria ruminantium* was started by mating a male and female that had survived challenge with this agent. The progeny of brother-sister matings over 17 generations was challenged with the agent and next generation pairs were selected from the survivors of the biggest litters. It was found that over the first 15 generations an average of 63% mice were resistant. Over the first 15 generations, however, there was no significant increase of resistance above that of generation one. The resistance declined significantly during the subsequent generations and was totally absent at the 20th generation.

LABORATORY ANIMALS

VIROLOGY

OP-VIR.50 & 51: EXPERIMENTAL INFECTION OF WARTHOG (*PHACOCHOERUS AETHIOPICUS*) WITH AFRICAN SWINE FEVER VIRUS. 1980
G.R. Thomson, M.D. Gainaru and A.F. van Dellen

Although there were no obvious signs of illness following experimental infection of young warthog with African swine fever virus, the animals developed viraemias between $10^{2,4}$ and $10^{3,6}$ $HD_{50}/m\ell$ within the first week of infection, and virus concentrations in a number of lymphatic tissues attained high levels ($\geqslant 10^6 HD_{50}/g$). Unlike in blood, and to some extent in the spleen, virus titres in lymph nodes did not decline appreciably during the 33-day observation period, since at the end of the period lymphatic tissues from 2 warthogs were still infectious for domestic pigs to which these tissues were fed.

SUNDRY ANIMALS

PATHOLOGY

OP-ENT.24: STUDIES ON *PARAFILARIA BOVICOLA* TUBANGUI, 1934.
2. CHEMOTHERAPY AND PATHOLOGY. 1977
J.H. Viljoen and J.D.F. Boomker

The filaricidal effects of trichlorphon, arsenic trioxide, sodium antimony biscathecol disulphonate and nitroxynil against *Parafilaria bovicola* were the subject of this investigation. Levamisole hydrochloride was retested in a separate trial to assess the time required for healing after successful treatment.

A comparison of carcass lesions and the percentage of lesion area in untreated controls with those in treated animals reconfirmed the efficacy of levamisole hydrochloride, while nitroxynil gave more promising results. Both lesions and lesion area were reduced by 76% by the former and by 93% by the latter compound. The other drugs only slightly suppressed *P. bovicola* activity.

After treatment with levamisole hydrochloride, active lesions were still present for 1-4 weeks and visible lesions on slaughter for 8 weeks. Since the visible lesions during the 8 weeks varied from acute to chronic and as they disappeared 9 weeks post treatment, it is suggested that provision should be made for a healing period of at least 9 weeks.

SUNDRY ANIMALS

BIONOMICS

OP-ENT.33: LABORATORY STUDIES ON THE BIONOMICS OF MUSCID FLIES ASSOCIATED WITH CATTLE, WITH SPECIAL REFERENCE TO THE SUBGENUS *EUMUSCA*. 1981
B. Sutherland

Apart from the existing colony of *Musca xanthomelas*, a second colony of a closely related new species *Musca* sp. ign. was established by replacing citrated blood with ox liver and full-cream milk powder as source of protein.

Controlled cross-mating experiments confirmed that these are 2 distinct species since eggs of both crosses were sterile and matings between species were accidental.

Eggs of both *Musca* species could not survive below 10 °C. Similarly pupae of both species could not survive prolonged exposure to temperatures of 15 °C and lower. At shorter exposure periods pupal eclosion decreased linearly. Both fly species will therefore be unable to overwinter in the egg or pupal stage. The upper temperature tolerance limit for these stages was 35 °C.

The method of physiological age-grading developed previously for *Stomoxys calcitrans* could be applied to *M. xanthomelas* and *Musca* sp. ign. without any changes being made.

SUNDRY ANIMALS

PATHOLOGY

OP-ENT.32: APPEARANCE OF RICKETTSIA-LIKE MICRO-ORGANISMS IN THE ADULT BONT TICK *AMBLYOMMA HEBRAEUM.* 1980
Josee M.B. Stuyven

The appearance of rickettsia-like micro-organisms in the adult bont tick, *Amblyomma hebraeum* (Acarina - Ixodoidea) (OP-strain) was investigated, mainly to differentiate between pathogenic and symbiotic rickettsiae.

Use was made of light microscopic examination of smears of *A. hebraeum,* serological tests to identify pathogenic rickettsiae and electron microscopic observation of micro-organism ultra-structure. Rickettsiae were also isolated in embryonated chicken eggs and in guinea-pigs and an effort was made to kill symbionts with an antibiotic in order to determine their possible role in Ixodoidea.

The occurrence of rickettsia-like micro-organisms is confined to the ovaria and Malphigian tubules. By application of the haemolymph test it was determined that a small percentage of *A. hebraeum* males and females is infected with a pathogenic *Rickettsia.* Multiplication of rickettsiae in embryonated chicken eggs and in guinea-pigs led to the first identification of pathogenic rickettsiae, which belong to the spotted fever group, and are most probably *Rickettsia conori* as confirmed by antibody complement fixation tests.

Electron microscopic observations show the presence of intracellular *Wolbachia*-like symbionts, varying in size from 1,2 μm to 3 μm, in the ovaria and Malphigian tubules of *A. hebraeum.* The organism is differentiated into a dense cortical region and a lighter cytoplasmic matrix containing a diffuse reticulum, ribosomes and nucleoid bodies. An outer multimembrane cell wall encloses the organism which is situated in a membrane-bound vacuole. Multiplication occurs by transverse binary fission.

The pathogenic *Rickettsia* sp. can be readily distinguished from this symbiotic *Wolbachia* sp. by the presence of a characteristic halo zone which surrounds the pathogen. Furthermore the *Rickettsia* sp. is noticeably smaller than the symbiont and varies in size from 0,4 μm to 1,3 μm. An outer cell wall and an inner plasma membrane are separated by a periplasmic space. The cytoplasm consists of an amorphic ground substance. At high magnification a capsule-like layer can be observed near the outer cell membrane.

A. hebraeum females fed through subsequent larval and nymphal stages on an antibiotic treated host clearly showed feeding and reproductive disturbances in the adult stage. Because the symbionts are also affected, it is postulated that the *Wolbachia* sp. fulfils a possible function in the reproductive process of *A. hebraeum.*

ANIMAL HEALTH SERVICES

Vaccines and Animal Disease Remedies

PRODUCTION OF VACCINES

BACTERIOLOGY

OP-BACT.57: SPORULATION BY *BACILLUS ANTHRACIS.* 1981
A. Botha, C.M. Cameron and W.J.P. Fuls

With the objective in mind of preparing anthrax vaccine in liquid culture, extensive studies were undertaken on the chemical and physical conditions required for sporulation. None of these attempts yielded any positive results.

Subsequently a number of published media were compared and the best one selected. It was further found that the time of incubation, the temperature, the size and shape of the vessel, the volume and the method of aeration are all critical factors for sporulation.

Taking into account the above variables, a practical method was devised for the production of anthrax spore vaccine in liquid culture.

PRODUCTION OF VACCINES

BACTERIOLOGY

OP-BACT.59: THE CULTIVATION OF *CAMPYLOBACTER FETUS* IN LIQUID MEDIUM. 1981
A. Botha and C.M. Cameron

Existing liquid media for the cultivation of *C. fetus* contain sodium succinate and other compounds which make them too expensive for vaccine production and do not adequately support the growth of fastidious strains.

After extensive studies the following medium was compiled: bacteriological peptone 20 g, yeast extract 5 g, NaCl 3 g, aspartic acid 2,5 g, glutamic acid 2,8 g, $CaCl_2$ (2 % sol) 1,0 mℓ, $MgSO_4$ (1 %) 1,0 mℓ, distilled water 1 ℓ, final pH 7,0.

This medium is now used for the production of seed material and the mass cultivation of fastidious strains.

PRODUCTION OF VACCINES

BACTERIOLOGY

OP-BACT.61: COMPOSITION AND EVALUATION OF THE EFFICACY OF A *STAPHYLOCOCCUS AUREUS* VACCINE. 1979
C.M. Cameron

An alum-precipitated *Staphylococcus aureus* vaccine, composed of a formalin-inactivated whole culture of a strain which produces Smith surface antigen and combined with the whole culture of a highly toxigenic strain, was found to afford a good immunity to staphylococcal skin infection in rabbits.

Three injections of the vaccine provided immunity which lasted for at least 6 months against a primarily pyogenic strain of *S. aureus* and for at least 3 months against a toxigenic strain.

From experiments using vaccines prepared from cells or toxoid only, it was deduced that, although there is a measure of strain specific immunity, a good heterologous immunity can be established with a combined product provided that it contains adequate quantities of toxoid.

The use of such a vaccine as a potential aid in the control of bovine staphylococcal mastitis is discussed.

Publication

CAMERON, C.M., 1979. Composition and evaluation of the efficacy of a *Staphylococcus aureus* vaccine. *Onderstepoort J. vet. Res.* 46, 1-8.

Diagnostic Services

ALL DIAGNOSTIC SERVICES

PATHOLOGY

OP-TOX.16: INVESTIGATIONS OF TOXIC METABOLITES OF *PHOMOPSIS LEPTOSTROMIFORMIS* (KÜHN) BUBAK. 1976
C.H. van Aswegen

A silica gel purified methanol extract obtained from the pathogenic fungus *Phomopsis leptostromiformis* was separated into six main fractions with different toxicities on a DEAE-cellulose column with a 1 ℓ concentration gradient from 0,01 M to 0,08 M ammonium acetate (pH 8). The flow rate was 11,2 mℓ/cm^2/h. It was found that fraction 2b gave only one stable spot on TLC-plates in comparison with the other toxic fractions which decomposed to other possibly toxic and non-toxic fractions. Spots on TLC-plates were visualised with UV-light, ninhydrin and iodine vapour. The observation concerning decomposition or interconversion was confirmed by toxicity recoveries on DEAE-column

chromatography. Toxicity recoveries ranged from 32 % to 81 %.

Dialysis of toxin fraction 2b indicated a possible molecular mass smaller than 10 000.

Photometric analysis on fraction 2b revealed absorption peaks at 232, 279 and 340 nm. The specific extinction co-efficients ($E^{1\%}_{1cm}$) at 232 and 279 nm were 300,0 and 113,9, respectively.

The amino acid analysis on hydrolysed fraction 2b revealed the presence of most of the natural amino acids. With an unhydrolysed sample, no amino acid peaks could be detected.

The following results were obtained from a micro-analysis performed on fraction 2b: 42,56 %C, 5,71 %H and 8,38 %N. It was calculated that the amino acids represented 15,75 % of the nitrogen content of the toxic fraction.

Animal Disease Control

OTHER DISEASE CONTROL

PATHOLOGY

OP-POUL.12: LABORATORY AND FIELD OBSERVATIONS ON THE OCCURRENCE OF AVIAN RESPIRATORY MYCOPLASMOSIS IN SOUTH AFRICA. 1979

H.J. Venter

The initiative in respect of an eradication policy against mycoplasmosis in South Africa has mainly been taken by the large integrated poultry industry. At present, while all of the grandparent, and many of the parent flocks from these large organisations are free from both *M. gallisepticum* and *M. synoviae,* these infections are still prevalent throughout South Africa.

Indications of serological methods and the isolation and identification of mycoplasmas are given, with reference to the occurrence of 7 serotypes isolated in this laboratory between 1975 and 1978.

Certain field observations regarding the occurrence of avian respiratory mycoplasmosis are included.

AGRICULTURAL RESOURCE UTILISATION

RESOURCE CLASSIFICATION AND UTILISATION RESEARCH

Soil Science

SOILS

SOIL SCIENCE

N-Ce.141/1: EVALUATION OF RIDGE AND FURROW TECHNIQUES FOR WETLAND DEVELOPMENT. 1975-1981
A.F. Wilby

Farmers in Natal and East Griqualand have been attempting to develop wetlands for crop and pasture production for some time past. For this reason there was a great need to formulate guidelines to ensure safe use. This project was, therefore, undertaken from 1975 to 1980 with the main aims of gaining experience in layout and design of ridge and furrow systems on different forms of wetland and establishing design criteria.

Three different soil series (1 bottomland and 2 upland series) were selected on the Kokstad Research Station. Different design criteria were applied on each of the series.

Site 1: Bottomland - Katspruit/Katspruit

This site was split into three sections:

(a) base width 12 m - ridge height 1 m
(b) base width 12 m - ridge height 0,7 m
(c) base width 24 m - ridge height 0,7 m

On each site a rye grass/clover pasture was established. The pasture was irrigated at irregular intervals whenever it was thought necessary.

Slotted, rigid P.V.C. pipe was placed in the ridge of field "a" at the crest, mid-ridge and furrow and weekly water table readings were taken over a period.

Bulk density analyses of soil in the ridge in field "a" were carried out in 1975 and 1980 to assess changes in soil characteristics.

Site 2: Uplands - Longland/Waldene

The slope in this land varied from 4 % to 9 % and ridges were sited across the main slope. In places the fall in the furrows amounted to 7 %. This site was also split into three sections:

(a) base width 6 m - ridge height 0,33 m
(b) base width 10 m - ridge height 0,7 m
(c) base width 15 m - ridge height 0,7 m

In fields "b" and "c" one ridge was constructed with an offset crest, i.e. the crest was about 1 3 of the base width from the upper furrow. This was done to reduce slope percentage on the lower side of the ridge. All ridges were planted to dryland lucerne.

Site 3: Uplands - Kroonstad/Bluebank

The average slope of this land was 5 %. A series of ridges of 6 m base width and 0,33 m ridge height were alternated with the same width being left as a control between each series of ridges. Maize was planted on part of this land and oats on the remainder. Bulk density analyses were also carried out in 1976 and 1980.

Results

Site 1

It was noted that the 12 m base width ridges were constructed more quickly with less earth being moved than those with a 24 m base. Further, the ridge height of 0,7 m functioned just as well as the 1,0 m height and again was easier to construct.

Changes in bulk densities were noted.

Water table measurements were taken weekly from October 1975 to June 1977 and noted.
There was no visual evidence of erosion on Site 1.

Site 2

Here again the narrow ridge was found to be the easiest and quickest to construct. The ridges with the offset crests necessitated several unproductive runs as 1/3 of the ridge had to be ploughed so that earth was moved upslope only. It was noted that a reversible plough would help to cut down unnecessary tractor use on this type of ridge.

No bulk density or water table figures were obtained from this site.

Erosion was evident in the furrows of the 10 m and 15 m base width ridges where the fall was steep (7 %). Lack of cover on the ridges during the rainy season prior to the planting of lucerne also led to erosion on the fine tilth seed bed that had been prepared. On the narrow (6 m) ridges no erosion was evident.

Site 3

The narrow ridges worked well but there was no significant difference in crop production between the ridges and the control area. This is possible due to the upper ridges controlling the flow of surface water over the field.

Bulk density changes were noted.

Experience has been gained from these trials that has enabled general recommendations to be made for the development of wetlands. Base width has been standardised at 15 m for bottomlands with a consolidated ridge height of 0,7 m. Base widths of over 20 m are considered to involve too much construction work to offset "lost" ground in furrrows.

Crop response was not accurately monitored, but it can be reported that in all cases the crops were grown where no crops (or only very poor ones in the case of Site 3) could be grown before, due to waterlogging.

It is of interest to note the progressive stages of growth which took place in Site 1. During the first season there was no growth in the furrows. In the second season clover invaded this area. By the end of the third season both the rye grass and clover were growing well in the furrows, and the rye grass was dominant on the ridge crests. This is probably due to the root action breaking up the gleyed B horizon of the Katspruit series soil and enabling plants to establish and produce satisfactorily.

The changes in bulk densities appear most marked in Site 3 and the 35 cm depth of Site 1. Sheep grazing the rye grass/clover pasture in Site 1 have probably influenced the 5 cm level bulk densities although these also show an improvement. The generally lower bulk densities allow much better root penetration and moisture storage.

The water table shows the improved moisture regime of the soils, especially with reference to adèquate drainage. Furthermore, it suggests that there is little chance of over-draining these soils with the ridge and furrow system.

Many farmers in Natal are turning to wetland development in their efforts to intensify. Over 150 layouts (3 000 ha) have been designed in the field and more than 100 (1 500 ha) have been constructed. Only two of the layouts have proved problematic.

This project has been of great value to extension personnel in the region. Many formerly waterlogged soils can now be used for crop production without damaging natural resources. It can be safely stated that there is no deterioration of the soil caused by this form of cultivation, indeed the opposite applies.

It should be emphasised that this form of development merely controls the surface water and is not strictly a drainage system.

This relatively small low-cost project has been more than justified.

Publication

Wetland Development: Natal Region, 1977.

SOILS

SOIL SCIENCE

W-VI.15/5: PLANNING OF WATERLOGGED SOIL AND SALINE SOIL FOR OPTIMUM AGRICULTURAL UTILISATION. 1975-1981

J. van Zyl

Where perennial crops are grown under irrigation it is often necessary to install drains where waterlogging and saline conditions occur. This is a requisite that is very often overlooked by farmers when orchards or vineyards are established.

A thorough soil investigation should therefore be undertaken prior to planting in order to determine whether such constraints occur.

It is also necessary to determine whether the proposed drainage is economically justifiable.

Taking these facts into account a definite need for additional drainage was identified in the Stellenbosch extension ward. It was also found that the run-off water, which flooded lower lying soils, tended to be saline in some cases - readings between 100-300 ohm were often obtained.

It was therefore decided to lodge a programme to propagate the need to drain wet and saline soils and to prevent such conditions to develop. The results obtained from the "soil classification project W-Sb.147/3", gave very useful information. Soils indicated by the survey as marginal or unsuitable in respect of long-term cultivation were used in the drainage project.

In the planning and designing of a drainage system the permeability and depth of the soil play a major role. Where a soil could not be drained effectively and/or economically, alternative utilisation or cultivation practices were prescribed - as a rule this meant that the land was either established under permanent pasture or that the ridge and furrow system, of planting fruit trees and vineyards, was followed.

The main purpose was to use the minimum length of piping and inspection pits required and at the same time ensure efficient drainage. Grid systems were often installed as they proved to be the most economical. Inspection pits were positioned at the side of a land according to the preference of farmers. Spacing of the lines was usually dictated by the depth and/or the texture of the soil. The criteria used were <25 m shaving in heavier clay soils; 25-35 m apart in lighter sandy loam soils and 35-50 m apart in sandy soils. The depth of the lines, wherever possible was at least 2 m; this approach to drainage was followed up to the end of 1977. Thereafter a more scientific approach was adopted.

Various profile pits were dug in the area to be drained in order to study the profile of the soil. Between these pits, according to a grid pattern, several holes were augered which were then left open so as to allow the ground-water to stabilise in them.

The terrain was then surveyed and the positions of all the pits and holes noted. A topographical as well as a water-level contour map was compiled.

Permeability measurements were carried out in the auger holes with the necessary equipment. With this information available the propable depth and the spacing of the drainage lines were calculated. Minimum pipe diameters were also estimated according to the slope of the terrain and the volume of water to be coped with.

Each drainage system was therefore designed to its own requirements and no rule of thumb method was used.

Follow-up inspections were carried out at regular intervals on completed systems in order to determine what drainage efficiency had been attained.

Results indicated 80-100 % efficiency; the norm for 100 % efficiency was taken as the absence of any free water up to a depth of 1 m over the entire area drained.

For construction purposes, site level markers were erected from which the farmer could install the drain lines correctly.

The results achieved during the 5 years in which this project was launched, exceeded all expectations. The original aim was to drain 50 ha per year; however, in actual fact, 722 ha was drained; 869 ha was planned according to the soil classification project and technical advice was given on a further 432 ha where farmers installed drainage on their own initiative.

Two demonstration days were held during which farmers were instructed on the practical installation and implications of drainage systems - these days were very well attended. Soil and water samples were taken regularly every year to illustrate the beneficial effects derived from the drainage of saline soils. Very encouraging changes took place which highlighted the importance of the steps taken.

By means of a yearly circular letter farmers were also informed of the importance of regular maintenance of their drainage systems. A random test was once undertaken to ascertain whether farmers accepted the advice given in the circulars and it was found that 60 % of the farmers visited, acted on the information received.

From this effort, which started in Stellenbosch, wide-spread acceptance took place throughout the Winter Rainfall Region. According to the latest 1980/81 reports, 63 systems to the value of R124 272,00

were surveyed and 41 systems valued at R115 459,00 completed in the Boland Subregion.

In conclusion it can be stated that the aims set for this project were exceeded.

Surveys and Demarcation

REASONABLY HOMOGENEOUS FARMING AREAS

EXTENSION SCIENCE

W-VI.19/1: AREA DEMARCATION OF REASONABLY HOMOGENEOUS FARMING AREAS IN THE DRAKENSTEIN EXTENSION WARD. 1978-1981
P.M. Burger

This area is situated in the Upper Berg River Valley between the 32° and 34° longitudes. The climate is Mediterranean with frost-free mild winters and fairly dry summers.

The area comprises 27 land types and was demarcated into six reasonably homogenous farming areas based on climatological, topographical and soil pattern differences, as follows:

Franschhoek

The main soil types in this area covering 1 980 ha are Swartland, Glenrosa, Sterkspruit and Kroonstad.

This area has an average annual rainfall of 735 mm and the main climatological limitations to crop production are lack of sufficient winter cold and severe wind storms during summer.

The main crops are wine grapes and deciduous fruit.

Klein Drakenstein

The main soil types in this area covering 5 700 ha are Glenrosa, Hutton and Swartland.

This area has an average annual rainfall of 600 mm and the main climatological limitation is the occurrence of severe wind storms during summertime.

The main crops are wine grapes, guavas, canning peaches and citrus.

Simonsberg

The main soil types in this area covering 3 880 ha are Glenrosa, Hutton and Clovelly. Most of the land is on slopes.

The area has an average annual rainfall of 600 mm.

The main crops are wine grapes and canning peaches.

Groot Drakenstein

The main soil types in this area covering 4 240 ha are Fernwood, Westleigh, Longlands, Clovelly, Avalon and Dundee.

The area has an average annual rainfall of 816 mm.

The main crops are peaches, table grapes and wine grapes.

La Motte

The main soil types in this area covering 5 360 ha are La Motte, Fernwood and Oakleaf.

This area has an average annual rainfall of 800 mm.

The main crops are wine grapes, peaches and plums.

Klapmuts

Soils in this area are relatively shallow and poorly drained.

The main soil types in this area covering 7 750 ha are Kroonstad, Swartland, Glenrosa, Sterkspruit, Estcourt and Mispah.

The area has an average annual rainfall of 379 mm and the main climatological limitations are lack of sufficient water and low soil potential.

The main crops are vegetables, wine grapes and pastures.

The mountainous regions in the Drakenstein extension ward were not included in this demarcation.

REASONABLY HOMOGENEOUS FARMING AREAS

EXTENSION SCIENCE

W-VI.21/1: AREA DEMARCATION IN THE ROBERTSON EXTENSION WARD.
1978-1980
J.J. de Wet

The Robertson extension ward comprises the central part of the Breede River Valley which is bordered in the north by the Langeberg Mountain range and in the south by the Zonderend range, and includes the towns of Robertson, McGregor, Ashton and Bonnievale.

The purpose of the demarcation was to provide practical working fields for the purpose of extension and research in the context of area development. The criteria used were natural resources of soil pattern, macroclimate and availability of irrigation water, as well as the farming pattern which resulted from them.

The valley is divided roughly into two halves by the Breede River. On both sides intensive irrigation farming is practised mainly on the flood plain of the river with irrigation water supplied by three irrigation canal systems from the Brandvlei Dam in Worcester. The southern slopes of the Langeberg range, as well as the northern slopes of the Zonderend Mountains are cooler in summer, free of frost in spring and irrigation water from mountain streams and farm dams is scarce.

Rainfall of 150 - 300 mm per annum is higher in the eastern part of the valley, which also gets a higher proportion of summer rain.

Thus the extension ward was divided into six fairly homogeneous areas as follows:

Le Chasseur

This area, including Goree, Eilandia and Agter-Kliphoogte, is an intensive irrigation area with ample good quality irrigation water from the Le Chasseur canal directly from the Brandvlei Dam. The main climatic limitation is spring frost which causes considerable damage to wine grapes, from time to time. The main soil types of the arable land are Oakleaf, Hutton, Sterkspruit and Dundee. The farming pattern is typical of the Breede River Valley with 54 % under wine grapes and 13 % under peaches and apricots.

Langeberg

Langeberg comprises the south-western foothills of the Langeberg range, including the well-known areas of Vinkrivier, Hoopsrivier and Klaasvoogds. Summer temperatures are mild and the area is free of spring frost. Irrigation water is scarce and mountain streams the main source. Forty per cent of the arable land is used for vines, 9 % for stone fruits and the rest mainly for pastures and grain production. The main soil types are Hutton, Oakleaf and Dundee.

Mc Gregor

This area comprises the northern foothills of the Rivierzonderend Mountains, with climatic conditions very much the same as those of Langeberg. The main soil types are Dundee, Oakleaf, Shortlands and Hutton. Irrigation water is scarce. Thirty-four per cent of the arable land is used for wine grapes, 8 % for stone fruits and the rest for pastures and grain.

Goudmyn

Goudmyn forms the central part of the Robertson district. Ample irrigation water is available from Breede River canal systems. The main soil types are Hutton, Sterkspruit, Shortlands, Dundee and Oakleaf. Wine grapes, the main farming branch (40 %), suffer severe frost damage from time to time, but stone fruits (12 %) are fairly free of frost damage. This is a well-known area for the breeding of race horses.

Boesmansrivier

This area includes an extensive grain-growing area as well as irrigation farming in the Boesmans River Valley. The area gets more summer rains than the rest, but irrigation water in farm dams is very limited. Soil types are mainly Oakleaf, Dundee, Westleigh and Shortlands.

Bonnievale

This is a very intensive irrigation area on both sides of the Breede River with ample water supplies of deteriorating quality. The major climatic limitations are spring frost and summer rains. The soils are mainly of good potential, the Hutton, Dundee, Sterkspruit and Shortlands forms being dominant. Viticulture is the main farming branch (51 %) but stone fruits (13 %) and dairying are also important.

REASONABLY HOMOGENEOUS FARMING AREAS

EXTENSION SCIENCE

W-VI.22/1: DEMARCATION OF REASONABLY HOMOGENEOUS FARMING AREAS: STELLENBOSCH WARD. 1980-1981
J. Pienaar and J. van Zyl

The total area of the Stellenbosch extension ward which includes the apple-growing area of Elgin consists of 159 168 ha of which 68 505 ha is mountainous. The extension ward is divided into 59 land types which are, ignoring true land types, divided for convenience into three sub-areas, *viz* Stellenbosch highland; Grabouw basin; and coastal plains.

Stellenbosch Highland

This area consists of 63 955 ha with 18 515 ha being mountainous and encompasses 40 % of the extension ward. The area is again subdivided into six fairly homogeneous areas, *viz* (1) red slopes; (2) Helderberg; (3) Bottelary; (4) Koelenhof; (5) Vlaeberg; and (6) mountainous areas. The soils consist mainly of the following forms: Clovelly, Hutton, Glenrosa, Oakleaf, Mispah, Kroonstad, Avalon, and Pinedene. The rainfall of which about 80 % falls during the months May to August, is approximately 675 mm per annum. Cold wet winters with gale force N.W. winds and hot dry summers with occasional gale force S.E. winds are the pattern of weather in this area. The main branches of agriculture are wine grapes (vines) deciduous fruit, dairying and Turkish tobacco. Water resources consist of storage dams filled by winter run-off, mountain streams, rivers and springs but are inadequate in most cases.

Grabouw Basin

This area consists of 47 % of the extension ward and was divided into 29 land types which can be grouped together into five fairly homogeneous areas, *viz* (1) Red Hills; (2) Elgin Heights; (3) Lebanon; (4) Palmette; and (5) mountains. The total area is 74 540 ha of which 49 990 ha is mountainous. The cultivated part is incorporated into an undulating landscape and consists of the following soil forms: Hutton, Clovelly, Swartland, Glenrosa, Avalon, Pinedene, Estcourt, Kroonstad and Mispah. The climate varies from extremely cold winters to moderately warm summers. The rainfall is high and varies between 750 - 1 250 mm per year of which 60 % falls between the months May to August, accompanied by strong N.W. winds. Sources of water are very reliable and consist of large semi-state schemes, private schemes, rivers, mountain streams, springs and run-off storage dams. Highly intensive cultivation of deciduous fruit is practised in this area together with very advanced irrigation systems which makes this area an important earner of foreign exchange from the export of mainly apples.

Coastal Plains

This area comprises 13 % of the total extension ward and four land types occur. Three are actually grouped together and to differentiate, the area is divided into the two fairly homogeneous areas, Macassar and Kuils River. The flat landscape is underlain by the Fernwood, Longlands, Westleigh, Lamotte, and Kroonstad soil forms, which predominate. Climate is moderate with strong N.W. winds in winter and some gale force S.E. winds in the summer. Rainfall is approximately 625 mm per year and falls from May

to August. Irrigation water of good quality is very scarce and is obtained mainly from boreholes and from the lower courses of the Eerste and Kuils Rivers. Agricultural activity consists mainly of animal production of which dairying plays an important role and vegetable production occurs to a lesser degree. A large part of this area is reserved for industrial and residential use, which rapidly expands in this area.

Publication

PIENAAR, J. & VAN ZYL, J., 1979. Afbakening van redelik homogene boerderygebiede in die voorligtingswyk Stellenbosch. *Elsenburg J.* 3(3), 1-13.

REASONABLY HOMOGENEOUS FARMING AREAS

EXTENSION SCIENCE

W-VI.23/1: AREA DEMARCATION OF REASONABLY HOMOGENEOUS FARMING AREAS IN THE WELLINGTON EXTENSION WARD.
1978-1981
D.M. du Toit

The Wellington extension ward, stretching from Franschhoek in the south to the Koopmans River in the north and from the Klein Drakenstein mountains in the east to the Joostenberg in the west, is subdivided into two extension regions, i.e. Drakenstein and Wellington.

In the Wellington extension region the 24 land types, based on climatological, pedological and terrain differences were grouped into eight reasonably homogeneous farming areas. Land types with the same broad soil pattern and relatively small differences in climate were grouped together as follows:

Paarl

The main soil types in this area covering 2 150 ha on the eastern and northern slopes of Paarl mountain are Hutton, Clovelly and Glenrosa.

This area has an average annual rainfall of 943 mm with warm dry summers and cool wet winters. The main climatological limitations for crop production are lack of sufficient winter cold for certain deciduous fruits, summer drought and occasional heat waves.

The main farming enterprise is table grape production for the export market.

Perdeberg

The main soil types in this area covering 3 130 ha are Kroonstad, Mispah, Cartreff, Clovelly, Hutton, Fernwood and Sterkspruit.

The climatic limitations are the same as for Paarl.

The main farming enterprises are wine and table grape production.

Groenberg

The main soil types in this area around Groenberg covering 8 660 ha are Glenrosa, Hutton, Swartland and Cartreff.

The climate corresponds to that of Paarl, but severe wind storms during summer limit crop production.

The main farming enterprises are wine grapes, vine nurseries and guava production.

Berg River

The main soil types in this area covering 11 170 ha are Sterkspruit, Glenrosa, Swartland, Kroonstad and Estcourt.

The climate corresponds to that of Paarl.

The main farming enterprises are deciduous fruit, table grape and wine grape production.

These crops are mostly grown on the subdominant soils (Oakleaf, Westleigh, Dundee and Avalon) along the banks of the Berg River.

South Agter-Paarl

The main soil types in this area covering 1 010 ha are Hutton, Clovelly, Fernwood and Kroonstad.
The climate corresponds to that of Paarl.
Because of lack of irrigation water the main farming enterprise is dryland wine grape production.

Agter-Paarl

The main soil types in this area covering 19 180 ha are Swartland, Glenrosa, Sterkspruit, Kroonstad, Estcourt and Valsrivier.
The rainfall is less in this area than in Paarl. The cool south-westerly winds blowing in summer cause a fairly mild climate.
Drought in summer and waterlogging of soils in winter are the main limitations.
Winter wheat, wine grape, Oriental tobacco production and sheep farming are the main farming enterprises.

Hermon

The main soil types in this area covering 10 980 ha are Swartland, Glenrosa and Sterkspruit.
The climate corresponds to that of Agter-Paarl but wind storms in summer are more severe.
The main farming enterprises are winter wheat production and sheep farming.

Voëlvlei

This area covers 10 570 ha and the main soil types are Glenrosa, Swartland, Kroonstad, Sterkspruit, Estcourt, Dundee, Oakleaf, Valsrivier and Mispah.
The climate and farming patterns are much like those of Hermon, but the rainfall is higher.
Waterlogging of soils during wet winters is a serious limitation to crop production.
The mountainous regions in the Wellington extension region were not included in this grouping.

REASONABLY HOMOGENEOUS FARMING AREAS

EXTENSION SCIENCE

W-VI.32/1: DEMARCATION OF REASONABLY HOMOGENEOUS FARMING AREAS IN THE VREDENDAL EXTENSION WARD. 1980-1981
D.F. du T. Badenhorst

The Vredendal extension ward consists of three distinguishable regions namely:
The intensive irrigation region.
The grazing and grain-productive region.
The extensive grazing region.
The total area of the ward covers 1 316 998 ha and has an annual rainfall of between 100 mm and 400 mm.
The aim of this study is to demarcate the reasonably homogeneous farming areas, based on climatical, topographical, vegetation and soil characteristics, in such a way as to justify the determination of production techniques and yield norms. The intensive irrigation areas are subdivided into two areas; the grazing and grain areas into six areas; and the extensive grazing areas into four areas.
Topographically the extension ward has even to undulating plains from the coast eastwards to where the area stretches over various mountain ranges.

Swartdoring River Region

This region covers approximately 243 331 ha with an annual rainfall of between 120 mm and 170 mm. Very hot summers are experienced with January and February being the hottest months. Topographically this area changes from undulating to steeply undulating and mountains. The soil consists of the northernly coarse sandy soils and supports a veld type known as "Brokenveld".

REASONABLY HOMOGENEOUS FARMING AREAS

The "Knersvlakte" Region

This region covers 642 122 ha which constitute 48,75 % of the total area of the extension ward. It is known for its lack of water and the larger part has a rainfall of about 120 mm per annum. Topographically it consists of vast plains that are even to undulating. The soil is composed of "Knersvlakte" coarse sandy loam and "Knersvlakte" fine sandy loam. The vegetation consists of two veld types, namely the "mesemveld" and the high-growing "mesemveld". Only extensive sheep and goat farming are practised in this area.

The Nuwerus-Bitterfontein Region

This region covers 118 447 ha and constitutes 8,99 % of the total area of the extension ward. The region is locally known as the "Hardeveld" and has an average annual rainfall of approximately 150 mm. The highest daily maximum temperature varies between 37 °C and 40 °C. South-westerly winds play a very important part in the months of October till March, and it is necessary to take preventative action against wind erosion, especially where wheat is produced. Only underground water sources are available. Topographically this region is undulating to steeply undulating. Three-quarters of this region consists of Nuwerus-Bitterfontein loam and clay - sandy soils, and the veld consists of two types, namely, the high-growing brokenveld and the shrubveld. Sheep and grain farming are the main production enterprises.

Coastal Grazing Region

This region covers about 148 957 ha of which 135 841 ha fall within the Vredendal extension ward, and 13 116 ha in the Clanwilliam extension ward. The region constitutes approximately 9,7 % of the total area of the Vredendal extension ward. It has an average annual rainfall that varies from 150 mm in the north to 200 mm in the south.

The region relies mainly on underground water and topographically it consists of even to mildly undulating plains. The soil is mainly of the coastal fine sandy type which supports a vegetation consisting mainly of shrubveld. The farming pattern once again consists mainly of sheep and grain farming.

The "Urionskraal" Region

This region covers about 14 900 ha and constitutes 1,13 % of the total area of the extension ward. It has an average annual rainfall of between 180 mm and 250 mm. The summers are very hot and the easterly winds can reach gale force in September and October. Topographically it is an even to mildly undulating plain. The soil is of the Vanrhynsdorp-Olifantsrivier sandy loam type but it is very shallow. The vegetation consists mainly of Karoo-type succulents. A small percentage of sheep farming is practised whereas grain farming is the main enterprise.

The Plateau Region

This region covers about 58 798 ha of which 37 274 ha are in the Vredendal extension ward, and 21 524 ha in the Clanwilliam extension ward. The area constitutes 2,83 % of the total area of the Vredendal extension ward. It is formed by the crests of Nardowsberg, Gifberg and the Matzikama Mountains. The region has an average annual rainfall of 250 mm to 400 mm and mild summer of temperatures are experienced. Severe frost may occur in winter. The most important topographical characteristic is its height above sea level which varies between 480 and 600 m. The soil consists of the Clanwilliam coarse sandy type which originates from Table Mountain sandstone, and has a low pH value. The vegetation is mainly high-growing fynbosveld which has a dense growth. Most of these plants are inedible. Farming consists mainly of sheep, grain and "rooibostee" production.

Graafwater Region

This region covers approximately 156 637 ha of which 95 255 ha are within the Vredendal and 61 382 ha in the Clanwilliam extension ward. The area constitutes 7,23 % of the total area of the Vredendal extension ward. It has an average annual rainfall of approximately 170 to 250 mm and as such has the most advantageous distribution of all the sheep and grain-farming areas in this extension ward. Mild summer temperatures prevail, mainly because of a temperature reduction in the afternoons attributed to coastal breezes. The topography is mainly even to mildly undulating. There are six different types of soil in this region; the main types being Clanwilliam coarse sand, "Steenboksriet" sand and "Sonkwasriet" sand. "Steenboksriet" veld is the most important vegetation, with small patches of fynbosveld,

semi-succulent bush and succulent bush. The veld of this region is mainly sour and of poor quality. Mainly sheep and grain farming are practised.

Mountains and Rocks

This region consists of 205 398 ha of which 14 081 ha fall within the Vredendal extension ward. It is not easily accessible and only small patches are used for grazing.

The Koekenaap-Lutzville Irrigation Region

This intensive irrigation area consists of approximately 3 622 ha and constitutes 0,27 % of the Vredendal extension ward. The temperature of this region is lower than that of the Trawal-Vredendal irrigation region, because it is located nearer to the sea and subjected to the effect of a south-westerly to southerly breeze. The soil consists mainly of three types, namely, alluvial soils, sandy loam soil and sandy soils. Large areas of silty soil occur between Lutzville and Koekenaap on the banks of the Olifants River. Because of the relatively even topography the water level is very high and most of the silty soils are brackish. The farming consists of wine grapes, raisins, factory tomatoes, lucerne, "lappiesboontjies" (beans), potatoes, coriander and mixed vegetables.

The Vredendal-Trawal Irrigation Area

This irrigation region covers 12 106 ha and constitutes 0,91% of the Vredendal extension ward. It has an annual rainfall of approximately 150 mm to 250 mm. The temperature is higher than that of the Lutzville-Koekenaap region and summer temperatures in excess of 40 °C are not uncommon. Strong easterly winds occur which could cause damage to wine grapes. Irrigation water is supplied by the Olifants River Government Water Scheme. Topographically it is level, but rises towards the canal banks. The soil varies from illuvial sandy loam to sandy and has a high potential. Farming consists mainly of wine grapes, raisins, factory tomatoes, market tomatoes, lucerne, potatoes and mixed vegetables.

REASONABLY HOMOGENEOUS FARMING AREAS

EXTENSION SCIENCE

W-VI.33/1: DEMARCATION OF THE REASONABLY HOMOGENEOUS FARMING AREAS IN THE BREDASDORP EXTENSION WARD. 1978-1981
C.W.G. Goldswain

The Bredasdorp extension ward is the southern-most district in the Republic of South Africa and is bounded in the east by the Swellendam district, to the north and north-west by the Caledon district and to the south by the Atlantic and Indian Oceans, meeting at Cape Agulhas.

The Bredasdorp extension ward takes up about 399 000 ha which is divided into 12 reasonably homogeneous farming areas, named and summarised as follows.

Sand Dunes

The area is 12 000 ha in extent, consisting mostly of sand dunes and is not used for agricultural purposes.

Dune Land

The area is 71 000 ha in extent. The soils are very shallow and rocky and therefore not to be cultivated. The vegetation consists of scrub with a low carrying capacity of about 15 ha per stock unit.

Strandveld Foothills

The area is 51 000 ha in extent. The soils are mostly sandy with a low fertility and with the 400 mm to 450 mm of rain, waterlogged at times. Wild flowers occur in fair quantities and are utilised in a farming practice.

REASONABLY HOMOGENEOUS FARMING AREAS

Mountain Area

The area is 35 000 ha in extent and contains the mountains of the district. Because of the rockiness of the area with its steep slopes, it is not cultivated. The vegetation consists of scrub and wild flowers which are utilised.

Between Dunes

The area is 32 000 ha in extent. Shallow soils with a slope of 0 % to 3 % in a rainfall area of 350 mm to 400 mm become waterlogged at times and restrict the arable land to about 30 %. Cereals are sown on a limited scale while more emphasis is lain on artificial pastures. The vegetation on the non-cultivated land consists of scrub with a carrying capacity of about 18 ha per large stock unit.

Strandveld

The area is 54 000 ha in extent. The slopes of the area vary from 0 % ot 13,5 %. The annual rainfall varies from 400 mm to 500 mm. The physical drainage of the soil is poor. The level soils in the lower areas sometimes become waterlogged while the higher situated areas with steeper slopes are not subjected to the same problem. Lucerne-grass-clover grazings are an economic farming practice while the production of cereals takes place on a limited scale.

Plain

The area is 12 000 ha in extent. The area is very level, but the soil is relatively deep and has a good physical drainage. The annual rainfall varies from 375 mm to 400 mm of which 30 % falls during summer and 70 % in winter. As a farming practice 90 % of the soil is cultivated and utilised with lucerne-grass-clover grazings in rotation with cereals.

Mountain Downland

The area is 7 000 ha in extent. The landscape is undulated with slopes that vary from 8 % to 30 %. The soil is suitable for artificial pastures, but less suitable for cereals. Mechanical protection should be applied to the soil. The annual rainfall varies from 400 mm to 450 mm.

Golden Triangle

The area is 54 000 ha in extent. The landscape is undulated with slopes that vary from 2 % to 13 % and therefore in some places needs to be protected mechanically. The soil is very suitable for artificial pastures and cereals utilised in rotation and 90 % is cultivated. The annual rainfall varies at around 400 mm of which 40 % occurs in summer and 60 % in winter. Water resources in the area are very poor.

Middle Downland

The area is 38 000 ha in extent. The landscape is very undulated with slopes that vary from 8 % to 20 %. Mechanical protection of the soil is a necessity. The soil is suitable for artificial pastures and cereals utilised in rotation and 85 % of the land is cultivated. The annual rainfall varies from 350 mm to 375 mm of which 35 % occurs in summer and 65 % in winter. Water resources in the area are poor.

Red Downland

The area is 19 000 ha in extent. The landscape is undulated with slopes that vary from 2 % to 10 %. Mechanical protection should be applied to the soil. The soil is very suitable for artificial pastures and cereals utilised in rotation. Sometimes the annual rainfall is a limiting factor for cereals because the specific type of soil becomes parched more easily. Annual rainfall varies from 350 mm to 375 mm of which 30 % falls during summer and 70 % in winter. About 90 % of the area is cultivated.

Crow Hills

The area is 14 000 ha in extent. The landscape is very undulated with slopes that vary from 10 % to 30 %. Mechanical protection of the soil is a necessity on the 70 % of the area cultivated. The soil is

suitable for artificial pastures and cereals utilised in rotation. The vegetation on the rest of the area consists of scrub with a low carrying capacity of 15 ha per large stock unit.

REASONABLY HOMOGENEOUS FARMING AREAS

EXTENSION SCIENCE

W-VI.34/1: DEMARCATION OF REASONABLE HOMOGENEOUS FARMING AREAS IN THE CALEDON EXTENSION AREA. 1979-1982
F.J.J. Carstens

The Caledon extension ward is situated approximately 120 km east of Cape Town and lies between the coastal line from Uilenkraalsmond to Kleinmond in the south and the Riviersonderend Mountain range in the north. Its boundary in the west is the Houwhoek, Groenland and Franschhoek Mountains and in the east the Bredasdorp and Swellendam districts.

According to terrain morphology, macro-climate and/or pedology, the Soil and Irrigation Research Institute has defined the area which covers approximately 383 120 ha into 60 land types. For the purpose of extension and determining of norms and techniques, these land types were grouped into eight relatively homogeneous farming areas. These areas differ significantly as far as soil types, macro-climate and topography are concerned.

Vyeboom-Villiersdorp

Land types Ic 88c, D6 93a, Ic 100a, Hb 28a, Fa 202a, Db 103a, Ib 103a, Gu 13a, Ic 101a, Fa 177a, Fa 201 and Ib 102a were grouped together to form this area, comprising 15 % (58 590 ha) of the Caledon extension ward.

The main soil types are Fernwood 25 %, Glenrosa 12 % and Swartland 10 %. The effective depths of these soils are respectively 400-1 200, 200-600 and 100-600 mm. The annual rainfall varies from 700 mm around Villiersdorp to 854 mm in the Vyeboom area. Rain is recorded mainly through the winter months. The main farming enterprises are grain and woolled sheep in the south-western parts of the area and fruit is cultivated under irrigation on the foothills and in the valleys near the mountains. Water sources for irrigation are the Riviersonderend and Elandskloof Rivers.

Riviersonderend Valley

Land types Fa 203a, Fa 203b, Ic 16b, Db 104a, Fa 204a, Fa 205a and Fa 210a were grouped to form this area. It covers 45 040 ha (12 % of the extension ward). The topography is rolling and 70 % of the arable land has slopes that vary from 10-15 %. The dominant soil types are Glenrosa 18 %, Swartland 12 %, Mispah 7 % and Dundee 7 %. The soil depth of the first three types varies from 100-350 mm and that of the alluvial soils (Dundee) from 900-1 200 mm. The rainfall increases from 410 mm in the west to 518 mm in the east, 57 % of which is recorded in the winter months.

Mixed farming is practised and woolled sheep, grain, wine grapes, vegetables and fruit all form part of the farming system. Frost is experienced on low-lying areas and strong north-western and south-eastern winds can cause serious wind erosion. The average farm size is 600 ha, 35 % of which is arable.

Bot River

Land types Ic 100a, Fa 207a, Ib 101a, Hb 32a, Db 105a and Fa 208a were grouped for this area which covers 20 410 ha (5 % of the extension ward). Owing to the rolling topography much of the land is difficult and unpractical to cultivate. Dominant soil types are Fernwood 13 %, Glenrosa 11 %, Swartland 11 %, Sterkspruit 10 % and Estcourt 10 %, with an average depth of 100-400 mm.

The average rainfall is 485 mm per annum, 71 % of which is recorded during the winter months.

Mixed farming is practised, but due to waterlogging on the shallow soil during the winter, the potential for wheat production is low. Vegetables and fruit are irrigated from the Bot River and other mountain streams. The average farm size is 900 ha, 60 % of which is arable.

REASONABLY HOMOGENEOUS FARMING AREAS

Caledon-Rûens

This area forms 17 % (64 950 ha) of the Caledon extension ward. Land types Fb 101a, Fa 206a, Fb 107a, Fa 206a, Fb 108a, Fb 110a, Fb 111a, Gb 15a and Ic 113 were grouped to form this area.

The dominant soil types are Mispah 26 %, Glenrosa 38 %, and Swartland 12 % with effective depths that vary from 100-200, 150-600 and 150-450 mm, respectively. Approximately 65 % of the arable soils are on terrain unit 3, with slopes of between 8 and 15 %.

The average annual rainfall varies from 368 mm to 536 mm in the vicinity of Swartberg. Approximately 70 % of the rainfall is recorded during the winter months. However, rains from the south-east can cause problems during harvesting time in October to November.

Underground water is very scarce and of poor quality, a factor which restricts livestock farming in this area. The main farming enterprises are woolled sheep and grain production. The average farm size is 860 ha of which 60 % is arable.

Rûens

This area covers 77 470 ha (20 % of the extension ward). The land types grouped together for this area are Fb 109a, Fb 536, Fb 40b, Fb 46b and Fb 121a. The dominant soil types are Mispah 27 %, Glenrosa 45 % and Swartland 20 % with effective depths varying between 200-500 mm. Approximately 70 % of these soils are on terrain unit 3 with slopes varying between 6-12 %.

The rainfall varies from 466 mm per annum in the south-western parts of the area to 409 mm in the north-western parts. Approximately 59 % is recorded during the winter months. South-eastern rains often cause crop damages during harvesting time in October to November.

Availability of water for livestock is also a major problem in this area. Woolled sheep and grain production are the major farming enterprises. The average farm size is 591 ha, 78 % of which is cultivated.

Diepgat

Land types Fb 112a, Fb 120a, Ib 104a, Ic 114a, Db 100a, Fb 119a, Fb 117b, Fb 118a and Fb 117a were grouped to form this area, covering 34 630 ha (9 % of the extension ward).

The dominant soil types are Mispah 20 %, Glenrosa 34 % and Swartland 17 % with effective depths of 150-250, 150-600 and 150-500 mm, respectively. The average annual rainfall varies from 450-600 mm, 65 % of which is recorded during the winter months. Waterlogging during this period is common and detrimental to crop production. Irrigation farming is practised along the Klein River and other mountain streams. The main farming enterprises are woolled sheep and grain farming in the area with a lower rainfall and vegetables under irrigation. The average farm size is 750 ha, 56 % of which is cultivated.

Strandveld

Land types Db 105a, Db 106a, Db 107a, Db 107b and Fa 209a were grouped to form this area covering 41 750 ha (11 % of the extension ward).

Dominant soil types are Glenrosa 16 %, Swartland 15 % and Estcourt 15 % with effective depths varying from 200-600 mm. Approximately 50 % of the arable land is on terrain unit 3 with slopes varying from 8-15 %.

The average annual rainfall is 550 mm, 64 % of which is recorded during the winter months. Due to soil depths and excess winter rain, waterlogging is also detrimental to grain production in this area. The main farming enterprises are woolled sheep, cattle and vegetables.

Coastal Valley

This area covers 40 280 ha (11 % of the extension ward). Land types Gb 4b, Hb 27a, Hb 33a, Hb 35a, Hb 14a, Hb 36a and Ib 106a were grouped together to form this area. The most important soil types are Fernwood 58 % and Mispah 19 %, approximately 80 % of which has slopes less than 8 %.

The average rainfall is 550 mm, 64 % of which is recorded during the winter months. Cultivation is limited to small areas and pasture crops, e.g. seradella and oats, are the most common crops under cultivation. The main farming enterprise is extensive beef production on veld. Vegetable production is limited to small areas where water from the Klein River and boreholes is available.

REASONABLY HOMOGENEOUS FARMING AREAS

EXTENSION SCIENCE

W-VI.37/1: AREA DEMARCATION OF REASONABLY HOMOGENEOUS FARMING AREAS (RHFA) IN THE RIVERSDALE EXTENSION WARD FOR THE PURPOSE OF AREA DEVELOPMENT. 1979-1981
P.N.J. Terblanche

The Riversdale extension ward, ± 452 000 ha, stretches from the Langeberge in the north to the sea in the south (Indian Ocean), and from the Gouritz River in the east to the Breë River (Witsand) in the west.

Fifty land types were identified and divided into seven RHFA. The grouping of land types was based on climatological, topographical and soil differences in such a way as to justify the determination of production norms for area development.

The following RHFA were demarcated:

Langeberg Foothills

About 50 % of this 40 000 ha area consists of mountains with high slopes, stretching out into several small valleys.

The main soil types are Glenrosa, Sterkspruit and Valsrivier forms which are found on the hills and Oakleaf and Dundee which are found in the valleys.

The mild climate and high rainfall of 750 mm/a make mixed farming (cattle, sheep and wheat) possible.

The main limitations are soil erosion on the steep hills and shallow soils.

The Rûens

The 15 land types (± 199 200 ha or 44 % of the extension ward) are demarcated into three RHFA.

(a) *Albertinia - Red Rûens*

It is a fairly flat carved table landscape area and 83 % of the soils are Hutton, Shortlands and Glenrosa types.

The rainfall is 375-500 mm/a, 50 % in summer and 50 % in winter. Farming enterprises are wheat, sheep and dairy farming. The limitations are an uncertain rainfall, wheat diseases and soil erosion.

(b) *Irrigation Rûens* (46 195 ha)

The main irrigation areas are:

(1) *Duivenhoks/Heidelberg* (18 530 ha)

An area of 953 ha is listed under this scheme. The main soil types are Dundee and Oakleaf on the first terrace and Sterkspruit, Valsrivier on the second terrace.

Limitations are lack of good canals for irrigation and water erosion on the steep and shallow soils.

(2) *Korrente-Vette Scheme* (18 440 ha)

An area of 2 062 ha is listed under this scheme. Soil types are Dundee and Oakleaf on the first terrace and duplex soils on the second and third terraces. The main limitation is lack of potentially deep soils for the high quality water that is available.

The Gouritz

The area is 9 000 ha in extent, 3 000 ha of which is under flood irrigation. The soil types are mainly very deep Dundee and Oakleaf forms. The annual rainfall is 450 mm which is a limiting factor as regards an irrigation practice in this area.

Limitations are the quality of water in the river which is low when it is not in flood, no storage dam to store the water (therefore there are no long-term enterprises) and the warm berg and south-east winds.

Middel-Rûens

The area is approximately 44 300 ha (10,2 % of the extension ward) in extent. The topography is of a very undulating nature, with isolated silcrete hills. The annual rainfall is approximately 450 mm, 58 % of which falls in winter. The soil types are mainly of the Swartland, Glenrosa, Sterkspruit and Shortlands forms.

Limitations are shallow soils, owing to excessive erosion on the hillsides, berg wind conditions and lack of water for livestock.

West Rûens

The area is approximately 74 000 ha (17,2 % of the extension ward) in extent. This area is next to the Middel-Rûens along the foothills of the Langeberg. It is less undulating than the Middel-Rûens but more arable. The soil types are Glenrosa, Mispah, Valsrivier and Swartland forms. The soil fertility level is high. The annual rainfall is between 400-450 mm, 61 % of which falls between April and September.

Wheat, wool and milk are the main farming enterprises. Limitations are lack of water for livestock and the saline water of earth dams and boreholes.

The Vlakte

This area is approximately 70 600 ha (16 % of the extension ward) in extent. This is a relatively flat area, 90 % of which is arable. Soil types are Hutton, Shortlands, Glenrosa and Mispah forms. Depth varies from 100-700 mm. There are no wind and soil erosion problems. Fertility of the soils is high. Of the annual rainfall of 400 mm, 60 % falls during the winter months. Farming enterprises are intensive wheat, wool and milk production on pastures.

Limitations are water for livestock and periodic droughts.

The Duine

This area is approximately 145 500 ha (32 % of the extension ward) in extent and it lies between the Indian Ocean and The Vlakte. It is an extensive grazing area with less than 1 % arable land. The type of vegetation present is "Kaapse Fynbos" grass and thatch grass. The main soil types are Fernwood and Mispah (Kalkbank series). Farming enterprises are cattle (milk and beef production) and sheep farming, as well as two natural products, namely thatch grass and sour figs. Although the four main rivers in the extension ward pass through this area to the sea, namely the Breë, Duivenhoks, Kaffirkuils and Gouritz Rivers, they are not suitable for irrigation purposes because of the saline effect of the sea water. The main limitation of the Fernwood soil form is its vulnerability to wind erosion and that of the Mispah soil form its shallow effective depth.

REASONABLY HOMOGENEOUS FARMING AREAS

EXTENSION SCIENCE

W-VI.38/1: AREA DEMARCATION OF REASONABLY HOMOGENEOUS FARMING AREAS IN THE SWELLENDAM EXTENSION WARD. 1979-1981

J.P. Pietersen

The Swellendam extension ward reaches from the Langeberge in the north to the coast in the south-east and from the town Riviersonderend in the west to the Heidelberg district in the east.

The approximately fifty land types were grouped into six fairly homogeneous farming areas, based on climatological, topographical and soil differences in such a way as to justify the determination of production norms for area development. Rainfall plays a very important part in this demarcation.

Langeberg Foothills

About 26 % of this 40 782 ha area is mountainous with steep slopes converging into several small valleys. The main soil types on the hills are Glenrosa and/or Mispah with Oakleaf and Dundee soils in the valleys.

The mild climate and relatively high rainfall of 500-725 mm/a which occurs throughout the year, make mixed farming possible: wheat, sheep, and dairy farming are practised under dryland conditions while peaches, wine grapes, youngberries, lucerne, vegetables and citrus are grown under irrigation.

The main limitation is the steep topography of the area.

Middle Rûens

About 80 % of this 83 030 ha area consists of dryland. The main soil types are Mispah and/or Glenrosa.

The average rainfall of 390 mm (40 % in summer) makes it suitable for winter wheat production, dryland lucerne, and sheep farming. Short-period (± 2 months) droughts occur often and affect optimum crop production.

Stormsvlei-Rûens

This area covers 42 100 ha consisting of 56 % dryland, 13 % valley soils and 31 % of renoster bush mountain slopes.

As a rule lime application is necessary on the slightly acid soils, with a relatively low rainfall (318 mm with 40 % in summer). Short drought periods occur often during the year, making wheat production risky, while high intensity rains lead to regular soil erosion.

The main farming enterprises are dryland wheat, lucerne and sheep, while lucerne and vegetables are produced under irrigation along the river border.

Breë River

This is a dry area of 29 090 ha with a low rainfall (poor distribution) of 283 mm and a typical Little Karoo nature.

Permanent water from the Breë River makes irrigation farming possible. Peaches, wine grapes, lucerne and dairy farming are the main enterprises while wheat production on dryland is regarded as a bit of a gamble.

The main soil types under irrigation are Sunvalley, Msinga, Avalon, Longlands and Fernwood.

Late frost (August) is the main climatological limitation for grape and peach production, while soils that become brackish constitute a real threat.

Malgas

This area covers 44 659 ha and has relatively steep slopes and Glenrosa as the main soil type.

The rainfall is low (290 mm), poorly distributed, with regular short to medium periods of drought, making wheat production very risky.

The main farming enterprises are winter wheat production and sheep farming.

Potberg

This area covers 21 090 ha, stretching from the top of the Potberg Mountains down to the flat landscape at the Breë River. As much as 54 % of the area consists of mountain fynbos.

Active farming operations are conducted only on a relatively small scale. Beef and sheep are kept mainly under veld conditions.

The rainfall is 400 mm, 60 % of which occurs during the winter.

SOIL CONSERVATION RESEARCH

Soil Conservation

EROSION

CONSERVATION STUDIES

T-V1.35/25: THE DESIGN OF A WATER RUN-OFF CONTROL SYSTEM FOR THE GEORGE'S VALLEY TARGET AREA. 1976-1981
C.P.J. de Jager

The aim of this project was to design a water run-off control system for George's Valley.

The network programs for "water run-off control planning" and "agricultural development" were

used to guide the implementation of the project.

A survey among 18 respondents was undertaken using a general questionnaire. A farm boundary and subdivision mosaic, a soil map and an inventory of conservation works have been compiled.

From the data collected, the following points became relavent:

The area comprises 3 594 ha, of which 4 % is cultivated, 9 % is perennial orchard and the remaining 87 % is veld and plantation. Of the 128 ha cultivated lands, only 55 ha must yet be contoured. This represents 1,5 % of the total area.

Only 28 % of the respondents are full-time farmers and 39 % actually live on their farms.

According to the soil map, the predominant form is Hutton.

The apparent absence of erosion can partly be ascribed to the fact that the soils are generally high in clay.

The 55 ha still to be contoured is made up of 21 separate land units. The average land size is therefore 2,6 ha. No artificial waterways need to be constructed in the area.

In the light of the above facts, it seems unnecessary to design a water run-off control system for the area. It is therefore proposed that this project be discontinued and that no communication program be registered for George's Valley.

EROSION

CONSERVATION STUDIES

W-VI.14/13: PROTECTION OF SLOPING LANDS IN THE KOPPIESVELD-VREDENBURG SOIL CONSERVATION AREA. 1974-1981

C.W. Blanckenberg

The Koppiesveld is a distinct area in the Vredenburg soil conservation area and is characterised by an undulating landscape in which knolls with steep slopes frequently occur. Run-off water from these slopes is concentrated on soils which are highly susceptible to erosion.

An extension project was launched in 1974 to protect 7 000 ha of land by contour systems before 1984. Progress exceeded expectations and by June 1978, 71,9 % of the target area was fully conserved. Since 1976, however, the enthusiasm of farmers in the area started to wane since 47 of the 49 farms involved in the project, were incorporated in the Vredenburg-Saldanha municipal area.

This development created uncertainty with farmers which made any further progress impossible and caused the project to be terminated.

EROSION

CONSERVATION STUDIES

W-VI.15/4: PROGRAMME FOR THE RECLAMATION OF SALINE WATER COURSES IN THE MOORREESBURG AND HOPEFIELD SOIL CONSERVATION AREA. 1974-1981

C.W. Blanckenberg

Parent materials of cultivated soils in the whole of the Moorreesburg soil conservation area and the eastern areas of Hopefield, have a high sodium yielding potential. As a consequence salts have accumulated in water courses and these have become saline.

An extension programme was launched in 1974 to fully reclaim 714 ha of saline water courses by fencing these in and establishing these to salt bush. Reclaimed land was to be included as pasture in existing grazing systems.

By June 1978, 413 ha (57,8 % of the area) was fully reclaimed, whereas 147 ha (20,6 %) was fenced off on both sides but not yet planted and a further 154 ha (21,6 %) fenced off on one side. According to grazing records of farmers, an average carrying capacity of 20 S.S.U./ha for 3 months of the year, was attained.

The establishment of saline water courses to salt bush is now undertaken spontaneously by farmers without any further encouragement.

This programme is now terminated as its goals have been attained. In addition, the area of land (0,5 %) involved, is relatively small and not suitable for projects at the optimal production level where large homogeneous areas are to be served.

COMMUNICATION

ENTREPRENEUR DEVELOPMENT

EXTENSION SERVICES

Programmed Extension

COMMUNICATION

EVALUATION

G.J.G. du Plooy: EVALUATION OF COMMUNICATION TECHNIQUES IN PROGRAMMED EXTENSION WORK.
(Research Project T-V1.37/1)
M.Inst. Agrar.: University of Pretoria. 1981
Supervisor: Prof. G.H. Düvel

The objective of this study was to determine which personal characteristics of sources and communication techniques applied in channels contributed to the success of a communication programme.

Data for this study were obtained by means of an interview schedule and postal questionnaire in the Thabazimbi extension ward, from 118 of the 120 farmers constituting the target audience of the communication programme.

Data were analysed by a computer according to an existing stepwise, multiple regression analysis programme. Independent factors included in the regression equations contributed at least significantly ($P<0,05$) to the variance of dependent factors. An F test was done by a pocket calculator on some subgroups of factors to determine whether the contribution thereof was highly significant ($P<0,01$). Multiple correlation coefficients were used to determine interdependence of factors, while the relative effect of factors was determined through multiple, semi-partial correlation coefficients.

From the psychological field theory of Kurt Lewin two mediating factors in the process of human behavioural change were identified, namely the cognitive structure of the psychological field and the valence or attractiveness of factors in the psychological environment. The finding of "perception" as the final mediating factor in the above process and the fact that perception and the psychological field can in a certain sense be viewed as synonymous (Düvel, 1975), indicate that the cognitive structure in respect of the innovation represents the person's perception of the relative advantages thereof, while the attactiveness thereof is represented by his perception of the compatibility aspects. By determining respondents' perception of these characteristics of the Open Controlled Selective Grazing System (OCSGS) it can be used, together with the effectiveness of application of the system, as a yardstick against which the effect of communication techniques can be measured.

The two identified mediating factors also concern the communication process. In this respect cognitive structure of the psychological field represents the extent of participation in the communication programme, while the attractiveness of programme factors represents the person's perception of the characteristics of sources and communication techniques applied in channels, in other words, the credibility thereof. By determining the extent of participation in and credibility of the programme, it could be correlated with the effectiveness of application and fairness of perception of the OCSGS.

Reasonable indications, supported by very high multiple correlation coefficients (R), were obtained that the extent of participation influences perception ($R = 0,882$) and application ($R = 0,789$) of an innovation (hypothesis 1). Indications were also found that the credibility of programme sources and channels influences the extent of participation ($R = 0,900$), the fairness of perception ($R = 0,883$) and the effectiveness of application ($R = 0,865$) of an innovation (hypotheses 2, 3 and 4). The coefficients also indicate that application is influenced by participation and credibility via perception, which supports the finding that perception is the final mediating factor in the process of behavioural change.

Confirmation of the above-mentioned hypotheses made further investigation possible of the relative contribution of nine selected characteristics of the extension agent and 22 communication techniques applied in five channels. It was found that all the characteristics and techniques contributed significantly ($P<0,05$) and as subgroups even highly so ($P<0,01$) to perception and application of the innovation. In most cases, however, the relative contribution of each factor additional to other factors, was found to be very small, mainly because of multicolinearity of factors, which adversely affects the validity of the findings. Certain conclusions were nevertheless drawn.

Concerning the physical, social and conceptual characteristics of the extension officer, indications were that he possesses certain characteristics of the aspects knowledgability, trustworthiness, goodwill and

dynamism which contributed to the success of the programme. This also indicates that all four aspects determine source credibility.

The investigated communication techniques were found to be able to satisfy the physical, social and conceptual needs of the clients. These techniques made active verbal and non-verbal participation and enough feed-back possible, while messages were repeated often and with enough variation, and audio-visual aids were used frequently.

The relationship between cost and effectiveness of the programme proved to be favourable, while study groups and newsletters were above average in comparison with the other channels in this respect. The extension officer spent most of his time on these two channels while other personnel were effectively incorporated in the programme.

SOILS

CONSERVATION STUDIES

T-Vl.35/7: THE DEVELOPMENT OF AN EFFICIENT FARMING SYSTEM IN THE STRYDOM BLOCK TARGET AREA. 1975-1981
P.J. du Toit

The aim of this project was to analyse the potential of the Strydom block area, to design farming patterns which are adapted to this particular area and to identify the problems and define them, bearing in mind the problems to design an extension programme which will serve as future base for cummunication programmes.

The general questionnaire of the Transvaal Region of the Department of Agricultural Technical Services was used in determining the present farming as well as the socio-economic situation. The technical questionnaire designed to determine practices which are in operation in the different farming ventures, was also used.

A 100 % sample was featured, but unfortunately four of the 19 farmers had to be left out for some technical reasons. The sample therefore consists of 15 farmers or 80 % of the target farmers.

Soil classification of the target area was done.

The multiple soil/climate/crop combinations of this area are the main reason why a definite farming pattern could not be determined. None of these farmers showed in the least any resemblance in their farming patterns.

By means of a technical questionnaire and observation it was clear that it was a heterogeneous area and the only two factors which are homogeneous are the natural resources, soil and water. Therefore an extension programme will be launched with the main focus points being soil and water. The most effective utilisation of the natural resources, soil and water, will be the objective.

With reference to the soil classification it was clear that soils tend to be shallow. The irrigation practices of farmers are very poor, and an excessive amount of water is used every week without any scientific schedule. The result is waterlogging and brackish conditions. A communication programme will be launched to persuade the farmers to utilise their soil and water correctly.

SURVEYS

CONSERVATION STUDIES

T-Vl.38/12: DEVELOPMENT OF ADAPTED FARMING SYSTEMS (PRINCIPLES) FOR THE LETABA BUSHVELD TARGET AREA. 1977-1981
W.B. Noel

Before programmed extension communication could successfully be initiated in the Letaba Bushveld extensive cattle ranching area, it was necessary to gain information concerning the farming community and their available resources.

A research phase of an agricultural development project was initiated for this purpose in January 1977. This phase took three years and nine months to complete with an input of 400 man-days. During this time, 23 827 km were driven and R1 873,00 spent on subsistence allowances.

The objectives were, firstly, to collect, analyse and interpret data concerning the natural resources

and the existing farming situation; secondly, to identify recognised and unrecognised farming problems, and, thirdly, to equip the extension office with sufficient information to formulate well-orientated communication programmes for the Letaba Bushveld.

The approach used was developed from the Network Programme for Agricultural Development in the Transvaal Region.

Two major field surveys were conducted to collect soil and vegetation data, while climatic data were obtained from a publication compiled by personnel of the Transvaal Region (1978). Geological data were obtained via personal contact with professional geologists in the field.

Geological, soil and vegetation data were roughly correlated to describe three major pedosystems with vastly differing production potentials.

The northern pedosystem with its undulating topography was found to have generally low-potential shallow gravelly topland soils supporting a rooibos-mopane sweetveld. The bottomlands supported a heterogeneous mopane-knobthorn mixed veld on fairly deep, dark apedal to strongly structured loam and clay soils. Those areas with higher potential soils were often seriously invaded by mopane.

The Central-Murchison pedosystem by contrast was flat or gently undulating with a predominance of deep red clayey Huttons which supported a Combretum-dopperkiaat sour-mixed veld in the west and a mopane-knopthorn-rooibos sweet-mixed veld in the east. The bottomland soils tended to be dark and fairly well structured.

The southern pedosystem was characteristically similar to that of the north, except for a lesser mopane problem and perhaps an overall sweeter, drier veld.

The Central-Murchison formed, therefore, a high-potential belt running from west to east through two low-potential granitic gneissic pedosystems.

Further, a demographic survey was conducted by personal interview. The questionnaire was designed specifically for this survey. For consistency all 38 respondents were interviewed by one officer. The hand analysis of the questionnaire made it possible to summarise information and identify problems concerning available resources, fixed improvements, stocking rates, managerial ability, production systems, marketing, breeding, herd management, veld management, supplementary feeding, record keeping, planning, levels of production, capital investment, income, debt and community co-operation.

The following were among the more important findings:

The spendable farm incomes (i.e. the surplus income after paying all farming costs other than operator's salary and compulsory interest and capital redemption demands) were found to be lower than R8 000,00 per year for 70 % of the respondents.

Capital debt for this group ranged from R10,00 to R26,00 per hectare.

Net farm incomes varied from R1,30 to R3,00 per hectare or R11,00 to R20,00 per mature livestock unit or R1,80 to R3,50 per R100,00 capital invested.

Leading up to this problem it was found that:

1. 87 % of the farms were too small for the given potential and the existing economic climate.
2. Production costs were exorbitant.
3. 63 % of farmers over-estimated carrying capacity.
4. 75 % of farmers lacked the knowledge needed to apply an efficient grazing system.
5. 70 % of farmers lacked the facilities (capital) to apply an efficient grazing system.
6. 66 % of farmers applied unadapted and haphazard production and marketing systems.
7. 60 % of farmers applied unadapted and haphazard breeding policies.
8. 62 % of farmers applied inefficient selection techniques for herd improvement.
9. 70 % of farmers experienced high direct losses due to diseases and predators.
10. There was insufficient information available concerning bush management.
11. Farmers lack knowledge concerning the nutritional value of the veld and the need for supplements.
12. Farmers lack knowledge concerning the economic production and utilisation of fodder crops and cultivated pastures.
13. The farming community was generally individualistic, unaware of shared problems and apathetic towards organisations.

A great number of other more specific problems have been referred to and discussed in the text.

These findings have been made available to provide, firstly, a launching pad for a communication programme; secondly, a benchmark to gauge change and progress and thirdly, a basis for determining solutions and achievable goals.

VELD

EVALUATION

OK-Do.74/1: EVALUATION OF THE STOCK REDUCTION SCHEME : VEGETATION CHANGE. 1972-1977.
T. Daines, R.A. Ingpen and L. Viljoen

A survey was conducted in the Upper Orange River catchment area of the North-eastern Cape on selected farms that were entered into the Stock Reduction Scheme and were totally withdrawn from grazing for the period of five years. The objective was to monitor the response of the vegetation, that had retrogressed due to drought and over-utilisation, to the total withdrawal of the grazing animal. The survey was conducted in the five major veld types as identified by Acocks (1978) in the North-eastern Cape, *viz*

No. 48 *Cymbopogon-Themeda* Veld
No. 50 Dry *Cymbopogon-Themeda* Veld
No. 58 *Themeda-Festuca* Alpine Veld
No. 59 The Stormberg Plateau Sweetveld
No. 60 The Karroid Danthonia Mountain Veld

Surveys were conducted annually to monitor changes in (1) botanical composition, (2) basal cover, (3) number of trees, shrubs and shrublets, (4) litter cover, and (5) production.

Total withdrawal of the grazing animal resulted in an overall improvement in the condition of the veld. The rate of improvement was dependent on the degree of retrogression and erosion that had taken place prior to the implementation of the enforced rest. The poorer the condition of the veld at the start of the rest period, the slower was the rate of improvement of the veld during resting.

Veld which was in excellent condition at the onset of the resting period, on the other hand, deteriorated and it is proposed that if similar schemes are introduced in the future to rehabilitate veld, careful attention be paid to the condition of the veld. Areas of veld, within farms, which are in excellent condition, should be excluded from prolonged resting from grazing to prevent veld retrogression taking place. It is also recommended that controlled grazing of veld in good to excellent condition within declared grazing zones, be allowed to prevent excess accumulation of moribund material that could lead to veld deterioration.

Prolonged resting of the veld led to a reduction in the population of shrubs and shrublets, especially *Chrysocoma tenuifolia.*

VELD

EVALUATION

W-Vl.16/5: VELD RECLAMATION OF THE CERES-KAROO. 1971-1981
P.B. van der Merwe

The purpose of the programme was to evaluate the Stock Reduction Scheme, to provide camps and stock watering facilities for improved veld management and to reclaim denuded patches in the very low-potential, vulnerable Ceres-Karoo.

Of the 248 674 ha veld in the area 105 500 ha were rested completely for 5 years and on the balance stock was reduced to two thirds of the estimated grazing capacity. In total compensation was paid for the withdrawal of 23 400 small stock units. Plant coverage improved during the 5 years from 16,2 to 26,8 % and the palatable plants increased from 3,6 % of total area to 6,1 %. Afterwards both total plant cover and palatability deteriorated again but was in 1979 still 32 and 47 %, respectively, better than in 1972.

In 1972 camps and stock watering facilities were inadequate on 34 of the 67 farms. These were all completed during the 5-year period, which made sound veld management possible on all the farms.

The bare patches could not be reclaimed by a rest period of 5 years and there is still no solution to the problem of reclamation of completely denuded veld under very severe and dry conditions.

AGRICULTURAL ENGINEERING SERVICES

Agricultural Engineering Apparatus

OFFICIAL TESTING

WATER REQUIREMENTS

(A)L-MI.32/16: OFFICIAL TEST PROGRAM FOR VINEYARD SPRAYING MACHINES IN SOUTH AFRICA: TESTING OF A THIRD SERIES OF VINEYARD SPRAYING MACHINES
(TEST REPORT No. 79031-42). 1977-1981
S.P.J. de Weerdt

Altogether 11 tractor-driven, vineyard sprayers were tested under field and laboratory conditions. Field tests were aimed at determining the ability of the machines to cover leaves in the vineyard with spray chemicals. Laboratory tests determined:

(i) Wear of nozzle components.
(ii) Wear of the pump.
(iii) Accuracy of the pressure gauge.
(iv) Pump throughput.

A series of 11 test reports on vineyard sprayers was published by the Department of Agriculture and Fisheries. These reports can be obtained from the Division of Agricultural Information or Agricultural Engineering.

PASTURE UTILISATION AND BOTANICAL RESEARCH

PASTURE UTILISATION RESEARCH: HIGH POTENTIAL AREA

Natural Pastures

VELD PASTURES

MANAGEMENT

OK-Do.50/6: STUDIES OF VARIOUS GRAZING SYSTEMS FOR DOHNE SOURVELD: THE RESPONSE OF *ELYONURUS ARGENTEUS* TO DIFFERENT DEFOLIATION TREATMENTS.
1971-1979
L.O. Nel

The investigation was conducted at Dohne Research Station in the Eastern Cape on typical sub-climax Dohne Sourveld (Veld Type 44: Acocks, 1975). The primary object was to determine whether *Elyonurus muticus* could be controlled by grazing management manipulations. The reaction of *E. muticus* to various grazing, burning and mowing treatments was studied in relation to the vigour and production of typical sub-climax Dohne Sourveld sward.

Results show that heavy and repeated defoliation of the sward to utilise *E. muticus* resulted in lowered vigour and production of the grass sward. This repeated heavy defoliation reduced seed tillering and vigour of *E. muticus*. This manipulation cannot be recommended for eradicating *E. muticus* because it results in loss of production of the more palatable species.

In the controlled selective grazing treatments that were applied, *E. muticus* was not grazed, while the vigour of the more palatable grass species in the sward was maintained. This treatment resulted in increased competition for the *E. muticus* plants and increased flowering and vigour of the more palatable plants. Overall, production of the sward was increased by applying controlled selective grazing and *E. muticus* was not a serious problem in the sward.

NASSELLA

PHYSIOLOGY

D.C. Joubert: ASPECTS OF THE PHYSIOLOGY OF GERMINATION OF NASSELLA TUSSOCK (*STIPA TRICHOTOMA* NEES).
(Research Projects OK-Do.68/11 and 68/12)
M.Sc.: University of Port Elizabeth. 1981
Supervisor: Prof. J.G.C. Small

The dispersal unit (diaspore) of nassella tussock is dormant and does not germinate under conditions usually suitable for germination. This dispersal unit is a fruit but is referred to as a seed and is completely enclosed by a lemma and palea. Seed with the enclosing glumes removed (naked caryopses) do, however, germinate. The optimum temperature for germination of the naked caryopses was found to be 28 °C.

Seed of nassella tussock is not very sensitive to the amount of water available during imbibition. The uptake of water is quite rapid and the outer glumae do not act as a barrier to water uptake.

Based on the fact that treatment with activated charcoal increased the germination of caryopses, it was deduced that a germination inhibitor was present in the seed. The outer layers appear to restrict the leaching of such an inhibitor. Surgical damage to the lemma, or the lemma and seedcoat, terminated dormancy. Germination of the naked caryopses was approximately the same in the light as in the dark.

Treatment with concentrated sulfuric acid for up to 7 min increased the germination of intact seeds.

An increase in the partial pressure of oxygen and a high temperature treatment did not affect germination at all. The same result was obtained with hydrogen acceptors (NO_2^-, NO_3^-, H_2O_2) and thiourea.

CYNODON

Plant growth substances BA (benzylaminopurine) and IPA (isopentanyl-adenine) stimulated germination of intact seeds in the light at 28 °C. Kineten (furfurylaminopurine) did not have the same effect. GA_3 (gibberellic acid) was found to be very effective in conjunction with stratification. Stratification alone promoted germination only to a certain extent.

Germination could be correlated with the amount of white light applied per day. Germination appears to be controlled by a HIR (high irradiation reaction) system.

Indications were that a substance was formed in the dark and that it stimulated germination.

Alternating temperatures increased germination. The greater the temperature difference within a temperature couple, the greater the stimulation.

In spite of the fact that BA did not cause germination in the dark at 28 °C, it did stimulate dark germination when combined with a fluctuating temperature.

In contrast with results at 28 °C, it was found that at alternating temperatures germination was stimulated in the light and in the dark by KNO_3 (potassium nitrate). This finding could probably be of practical value.

Perennial Cultivated Pastures

CYNODON

EVALUATION

OK-Do.63/9: INTRODUCTION AND EVALUATION OF PROMISING PASTURE SPECIES IN THE EASTERN CAPE: EVALUATION OF STARGRASS FOR BEEF PRODUCTION AT WOODBURY, KOMGA DISTRICT. 1976-1981
A.J. Aucamp and L.O. Nel

The Eastern Province Thornveld (Veld Type 7: Acocks, 1975) which covers about 2 000 km² of the Eastern Cape Region, has considerable potential for established pastures owing to its relatively high rainfall. No information is available in the Eastern Cape Region regarding the potential of stargrass for animal production. The potential of stargrass for beef production was investigated in the coastal region north-east of East London.

Results indicated that heavy stocking rates yield the highest production per hectare (996 kg *vs* 807 kg) whereas the light stocking rate is conducive to higher production per animal (151,8 kg *vs* 116 kg). The calculated optimum stocking rate is 7,83 tollies per hectare with a live mass production of 979 kg/ha. The calculated profit at this stocking rate is R155,00/ha. This indicates that a stargrass pasture can be used profitably to increase beef production in the coastal belt north-east of East London.

CYNODON

POTENTIAL STUDY

OK-Do.63/11(K): THE INTRODUCTION AND EVALUATION OF PROMISING PASTURE SPECIES IN THE EASTERN CAPE: GROWTH PATTERN OF STARGRASS (*CYNODON AETHIOPICUS*). 1976-1981
A.J. Aucamp

The Eastern Province Thornveld (Veld Type 7: Acocks, 1975) which covers about 2 000 km² of the Eastern Cape Region, has considerable potential for established pastures owing to its relatively high rainfall. No information is available in the Eastern Cape Region regarding the potential of stargrass for hay or animal production. The growth and production as well as its potential for beef production were investigated in the coastal region north-east of East London.

The rainfall fluctuated considerably during the experimental period. The unreliable rainfall consequently affected the production of stargrass considerably. The highest production of stargrass takes place during the period January to February, whereas the lowest is towards the end of the season. At the

beginning of the growing season the mean maximum dry matter production is 625 kg/ha/week, whereas it is 780 kg/ha/week during the period of January to February. During the last part of the growing season it is only 468 kg/ha/week.

The frequency of defoliation has a significant effect on the potential dry matter production of stargrass. Significantly less dry matter is produced with a two-weekly harvesting interval than with a four-weekly harvesting interval. The latter harvesting interval yields significantly less dry matter than six or eight-weekly harvesting intervals. There is, however, no difference in dry matter yield of stargrass with six or eight-weekly intervals.

The results show that the heavy stocking rate yields the highest production/ha whereas the light stocking rate is conducive to higher production/animal. The calculated optimum stocking rate is 9,06 tollies/ha. The calculated most profitable stocking rate is 7,83 tollies/ha with a live mass production of 979 kg/ha. The calculated profit at this stocking rate is R155,00/ha. This indicates that a stargrass pasture can be used profitably to increase beef production in the coastal belt north-east of East London.

ERAGROSTIS

MATHEMATICAL MODELLING

N-Ce.139/6: SYSTEMS SPECIFICATIONS AND SIMULATIONS FOR EXTENSION USE: *ERAGROSTIS CURVULA* PRODUCTION MODEL. 1977-1981
N.G.E. Hackland, P.J. Edwards, R.I. Jones and G.W. Cross.

The most common cause of problems in livestock farming in Natal is inadequate quality and/or quantity of feed supplies. This is probably true for the whole Republic. The problem is rooted in poor planning, together with outdated or inefficient production practices. It is aggravated, not caused, by drought or a drop in product prices.

One solution to the situation is fodder production planning, a process which includes a two-stage feed budgeting system. The first stage is the definition of the feed requirements of a specific herd. Secondly, the farm's potential for fodder production is estimated (Jones, 1978; Jones & Arnott, 1978). Part of the latter step was the subject of this project: the prediction of potential fodder production and its seasonal distribution with the use of mathematical models such as multiple regression.

This project presents a multiple regression equation accounting for 88% of the variation that occurred in some 270 individual annual yields of *Eragrostis curvula*. The data originated from nine sites in the eastern high summer rainfall regions in South Africa. The significant variables were level of applied nitrogen, rainfall, age of pasture and a combination of soil factors.

The "Richards" function was used to derive the seasonal distribution of growth rates of *E. curvula* at four of the nine sites. A procedure for predicting the corresponding production curve for a given farm site is proposed, based on the expected total yield and a selected standard curve.

This technique shows promise and it could be applied to other pasture species.

Publication

HACKLAND, N.G.E. & JONES, R.I., 1980. Predicting seasonal production of *Eragrostis curvula*. *Grassld Soc. sth. Afr.* Vol. 15. (In press.)

CULTIVATED PASTURES

EVALUATION

OK-Do.87/1: HERBAGE PRODUCTION TRIALS FOR PASTURE SPECIES SELECTION: *DACTYLIS GLOMERATA* IN THE EASTERN CAPE. 1977-1981
L.O. Nel

Ten cultivars of *Dactylis glomerata* and one of *Festuca arundinacea* were compared at Dohne in terms of dry matter yield and growth pattern. The experiment was affected by a severe drought during the second and third seasons (Table 1) and the stand was depleted by the end of the fourth season. The mean yield decreased from 9,2 to 1,4 t/ha/a during the experimental period (Table 2).

During the first season cultivars Currie and Aberystwyth S 37 yielded most herbage, but during the

last three seasons cv. Polycross yielded most and Currie second least. It seems possible that those cultivars that yielded most during the first more favourable season, were those with the higher yield potential, but those that yielded most during the subsequent seasons were the hardier cultivars (Table 2).

During the first season the growth fitted the double logistic function very well. The growth patterns of the various cultivars did not differ greatly, despite significant cultivar by harvest interaction effects (Table 3). A generalised growth curve was constructed over cultivars and the four seasons (Fig 1). This maintains a double peak pattern, but growth seems to decrease abruptly during February. This is possibly associated with the generally below average rainfall recorded during the late summer and autumn.

TABLE 1 - Analysis of variance of seasonal yields 1977/78 to 1980/81

Source of variation	Degrees of freedom	Mean squares	F
Replication	2	3 343 551	5,044**
Cultivars (C)	10	2 924 174	4,412**
Seasons	3	382 179 650	576,578**
C x S	30	1 064 046	1,605*
Error	86	662 842	
Total	131		

Grand mean 4 343,01
SD of a single yield = 815,15
Coefficient of variation = 18,75 %

TABLE 2 - Seasons x cultivars interaction table

Cultivar	Yield (and rank) 1977/78	1978/79	1979/80	1980/81
Polycross	9 357 (4)	5 201 (1)	4 550 (1)	2 920 (1)
Danish	9 115 (7)	3 512 (7)	2 719 (7)	2 745 (2)
Ky 31 fescue	8 918 (8)	3 059 (11)	2 438 (9)	1 128 (3)
Aberystwyth S 143	8 531 (11)	3 103 (9)	2 251 (11)	1 575 (4)
Aberystwyth S 26	8 904 (9)	3 077 (10)	2 898 (4)	886 (9)
Hera	8 545 (10)	3 633 (6)	2 321 (10)	1 099 (8)
Aberystwyth S 37	9 620 (2)	4 514 (2)	2 822 (6)	299 (11)
Currie	10 837 (1)	3 966 (3)	4 028 (2)	542 (10)
Apanui	9 240 (5)	3 914 (4)	2 496 (8)	1 824 (3)
Karkloof	9 214 (6)	3 662 (5)	2 833 (5)	1 602 (4)
Phyllox	9 423 (3)	3 271 (8)	3 268 (3)	1 229 (6)
Mean	9 246	3 719	2 966	1 441

Least significant difference for difference between values in table (P = 0,05) = 1 315

TABLE 3 - Cultivar x harvest interaction table for 1979/80 season

Cultivar	Yield (kg/ha) (and rank) Harvest date 79.09.27	79.11.29	80.03.17
Polycross	2 072 (2)	782 (1)	1 696 (1)
Danish	1 305 (4)	585 (3)	830 (10,5)
Ky 31 fescue	768 (8)	556 (4)	1 115 (9)
Aberystwyth S 143	574 (11)	300 (11)	1 378 (5)
Aberystwyth S 26	833 (7)	461 (9)	1 605 (2)
Hera	651 (9)	471 (8)	1 199 (8)
Aberystwyth S 37	1 060 (5)	548 (6,5)	1 213 (7)
Currie	2 281 (1)	552 (5)	830 (10,5)
Apanui	632 (10)	347 (10)	1 517 (3)
Karkloof	877 (6)	603 (2)	1 352 (6)
Phyllox	1 327 (3)	548 (6,5)	1 393 (4)
Mean	1 125	523	1 284

Least significant difference between values in table = 677 (P = 0,05)
Least significant difference between two differences in table = 957 (P = 0,05)

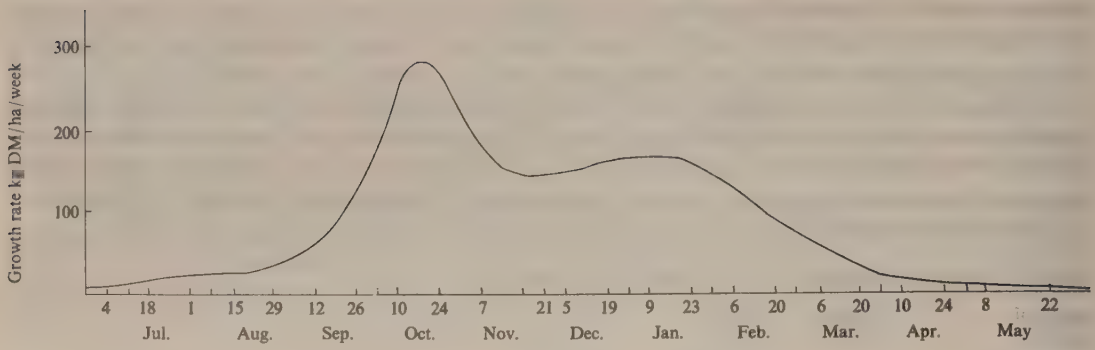
Growth rate kg DM/ha/week
300
200
100
4 18 1 15 29 12 26 10 24 7 21 5 19 9 23 6 20 6 20 10 24 8 22
Jul. Aug. Sep. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May

FIG. 1 - Growth rate of Cocksfoot in kg DM/ha/week meaned over period 1980/81

CULTIVATED PASTURES

POTENTIAL STUDY

OK-Do.63/8: THE INTRODUCTION AND EVALUATION OF PROMISING PASTURE SPECIES IN THE EASTERN CAPE: SCREENING OF SPECIES FOR VELD REINFORCEMENT IN THE DOHNE SOURVELD. 1975-1980

C.J.G. le Roux

The natural vegetation of the Dohne Sourveld has a low nutritional value and carrying capacity. Its climate is, however, suitable for intensified pasture production.

Six grasses and seven legume cultivars were screened for suitability in the reinforcement of Dohne Sourveld. Cocksfoot, Kentucky 31 fescue and *Phalaris tuberosa* seem suitable for the purpose. The use of Whittet kikuyu is restricted in some areas by its sensitivity to frost. *Trifolium semipilosum* is apparently more drought resistant than *T. repens,* but is also sensitive to severe frost. *T. pratense* seems to be more promising than was previously realised.

CULTIVATED PASTURES

POTENTIAL STUDY

OK-Do.63/10(K): CLIPPING TRIAL TO DETERMINE PRODUCTION AND QUALITY OF THREE GRASSES AT FOUR LEVELS OF NITROGEN. 1976-1981

A.J. Aucamp

The Eastern Province Thornveld (Veld Type 7: Acocks, 1975) which covers about 2 000 km² of the Eastern Cape Region, has considerable potential for established pastures owing to its relatively high rainfall. No information is available in the Eastern Cape Region regarding the potential of stargrass, Coastcross II and kikuyu for hay or animal production.

The rainfall fluctuated considerably during the experimental period (Table 1). The erratic rainfall influenced the production of the three grasses significantly (Table 2). The yield of kikuyu is significantly lower than that of stargrass or Coastcross II while no difference could be found between the latter. Results indicate (Fig. 2) that stems make the largest contribution to the yield of stargrass and Coastcross II. However, the three grasses produce the same amount of leaf material.

The level of nitrogenous fertilisation had a highly significant effect on the dry matter production of the three grasses (Table 3). The yield increased linearly up to 450 kg N/ha, after which it starts to level off. The quality of herbage is, however, such that a high level of animal production can be maintained (Table 4).

TABLE 1 - Rainfall at Woodbury in the Komga district, where the investigation was carried out

	Rainfall (mm)		
	1977/78	1978/79	1979/80
July	25,4	19,1	157,5
August	55,9	12,2	232,1
September	112,5	29,7	36,8
October	34,5	152,6	61,2
November	189,5	128,0	4,3
December	180,9	259,6	33,5
January	45,2	78,7	49,0
February	44,5	118,9	8,8
March	66,3	88,9	71,1
April	203,2	18,3	9,6
May	29,9	70,0	-
June	30,5	-	-
Total	1 018,3	976,0	663,9

TABLE 2 - Influence of species and years, as well as the combinations thereof, on dry matter production (kg/ha)

Species / Year	Stargrass	Coastcross II	Kikuyu	Average
1 (1976/77)	3 266	3 682	3 681	3 543
2 (1977/78)	12 340	13 141	10 402	11 961
3 (1978/79)	12 000	13 656	10 953	12 203
4 (1979/80)	7 160	8 744	5 632	7 178
Average	8 691	9 806	7 667	

SD within table	488,46	LSD	(0,5)	(0,1)
			1 365,72	1 803,87
SD of differences between Averages within table	690,78	LSD	(0,5)	(0,1)
			1 931,42	2 551,05

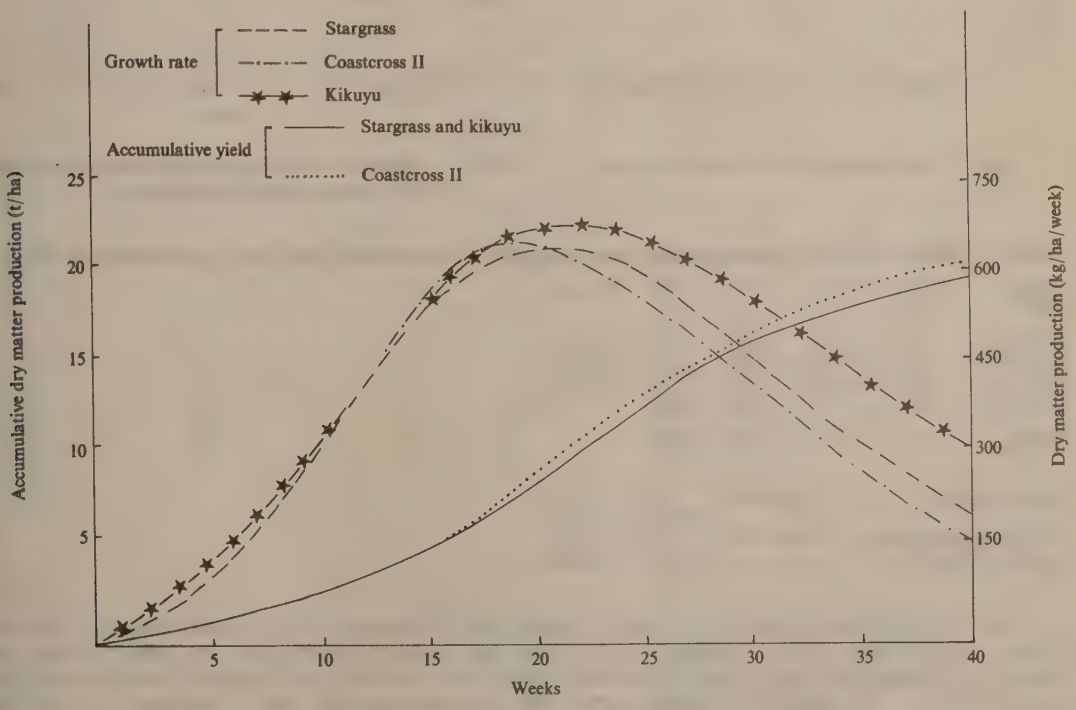

FIG. 1 - Accumulative dry matter production (t/ha) and growth rate (kg/ha/week) of stargrass, Coastcross II and kikuyu

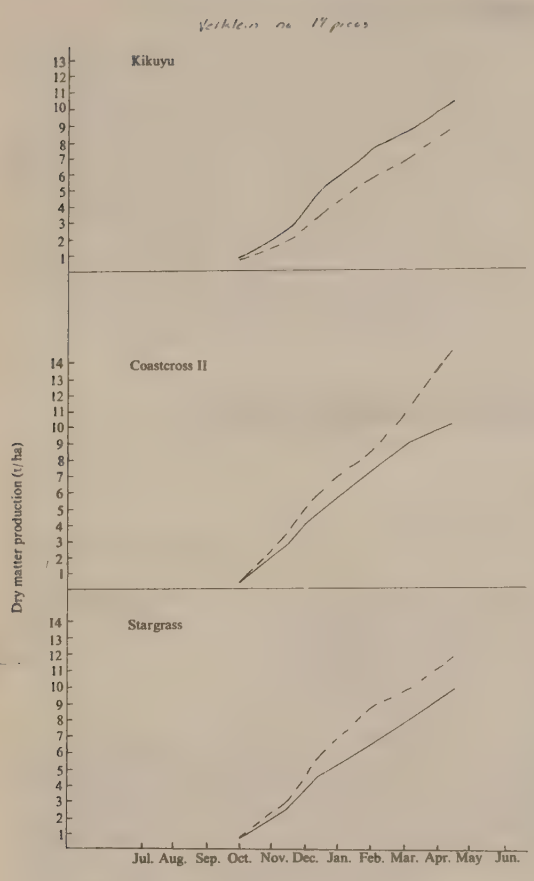

FIG. 2 - Yield of green leaves (—) and stems (— —)

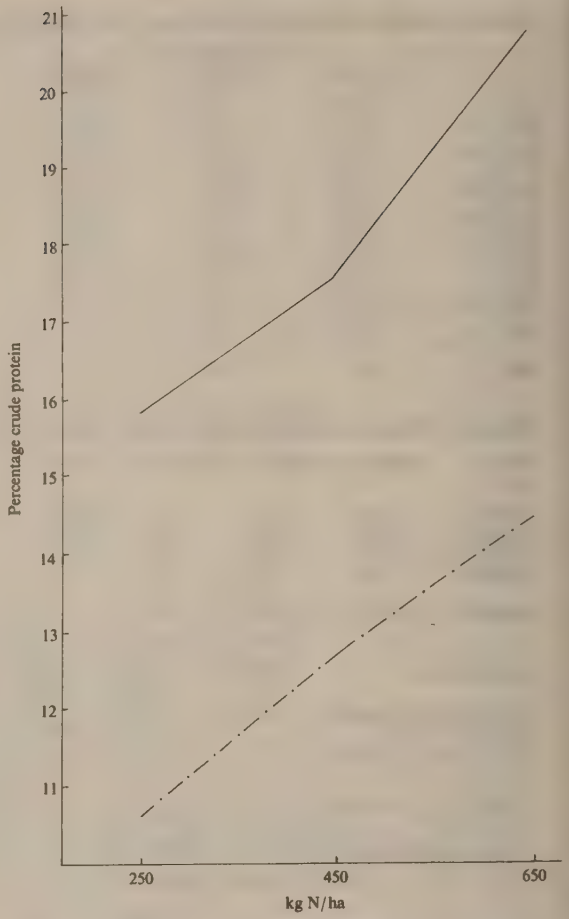

FIG. 3 - Influence of different nitrogen levels on the protein content of green leaves (–) and stems (–·–)

TABLE 3 - Influence of level of nitrogen application and years, as well as a combination thereof, on dry matter production (kg/ha)

Nitrogen Years	N1	N2	N3	N4	Average
1 (1976/77)	937	2 920	4 702	5 614	3 543
2 (1977/78)	2 788	9 179	15 886	19 991	11 961
3 (1978/79)	2 545	10 747	15 746	19 776	12 203
4 (1979/80)	1 628	6 143	10 052	10 893	7 179
Average	1 974	7 247	11 596	14 068	
SD within table		564,02	LSD	(0,5) 1 577,00	(0,1) 2 082,92
SD of differences between Averages within table		797,64	LSD	(0,5) 2 280,21	(0,1) 2 945,70

The derived growth curves of the three grasses under discussion (Fig. 1) show that the curve of kikuyu is identical to that of stargrass. The calculated highest growth rate (kg DM/ha/week) of Coastcross II occurs near to the end of December while those of kikuyu and stargrass occur towards the end of January. The calculated highest growth rate of both stargrass and Coastcross II is 625 kg DM/ha/week, and that of kikuyu 675 kg DM/ha/week.

TABLE 4 - Protein and fibre content of stargrass, Coastcross 11 and kikuyu

Percentage crude protein

	Species																							
	Stargrass									Coastcross II									Kikuyu					
	Nitrogen levels																							
	N2			N3			N4			N2			N3			N4			N2			N3			N4		
Date	GL	S	DL	GL	S	DL	GL	S	DL	GL	S	DL	GL	S	DL	GL	S	DL	GL	S	DL	GL	S	DL	GL	S	DL
77-09-30	25,0	25,3		27,3	25,2		27,6	19,1		23,0	15,8		25,1	27,0		25,3	28,2		25,9			26,4	24,5		26,3	24,8	
77-11-11	15,4	8,9		18,6	9,8		22,7	13,8		12,7	8,8		14,5	8,6		21,0	12,9		14,1	9,4		7,9	10,1		17,0	10,6	
77-12-14	15,7	15,8		19,2	10,2		23,4	13,8		14,6	7,6		18,0	9,2	14,9	22,4	13,9		13,9	9,5		19,5	13,5		21,5	14,8	
77-02-01	15,7	9,5		18,4	10,8		21,5	12,1	10,7	13,9	8,4		16,6	11,2		19,6	14,0	14,0	15,8	10,9		16,8	10,2		19,3	12,6	
78-03-15	11,1	6,0	7,3	12,3	6,8	7,0	13,0	6,7	8,5	9,7	5,5	8,5	9,6	6,2	8,9	16,8	9,0	12,0	10,5	6,4	6,6	12,4	7,8	8,6	13,3	9,3	8,8
Percentage roughage																											
77-09-30	21,7	26,3		17,0	28,9		23,2	26,9		21,5	26,0		22,7	26,7		23,4	28,6		20,9			21,4	20,5		21,3	22,4	
77-11-11	24,8	29,9		24,1	32,1		22,9	30,4		25,9	30,9		24,7	32,0		22,9	32,1		26,1	29,0		24,9	28,6		24,9	29,7	
77-12-14	27,7	34,7		24,5	37,3		23,0	35,7		29,9	35,3		25,7	35,8	29,7	22,0	35,1		30,3	34,4		25,7	31,9		26,3	32,7	
78-02-01	25,7	31,1		24,2	32,3		24,8	34,0	26,3	29,3	33,9		28,5	32,9		26,5	33,0	26,0	27,3	27,9		27,6	29,4		26,2	31,9	
78-03-15	28,5	33,0	27,2	26,6	33,9	25,3	26,9	34,6		30,5	33,8	28,4	34,3	32,8	28,9	25,7	34,5	28,3	31,4	32,8	29,3	29,9	33,7	28,2	30,1	32,7	27,4

N2 = 250 kg N/ha
N3 = 450 kg N/ha
N4 = 650 kg N/ha

GL = Green leaves
S = Stem
DL = Dry leaves

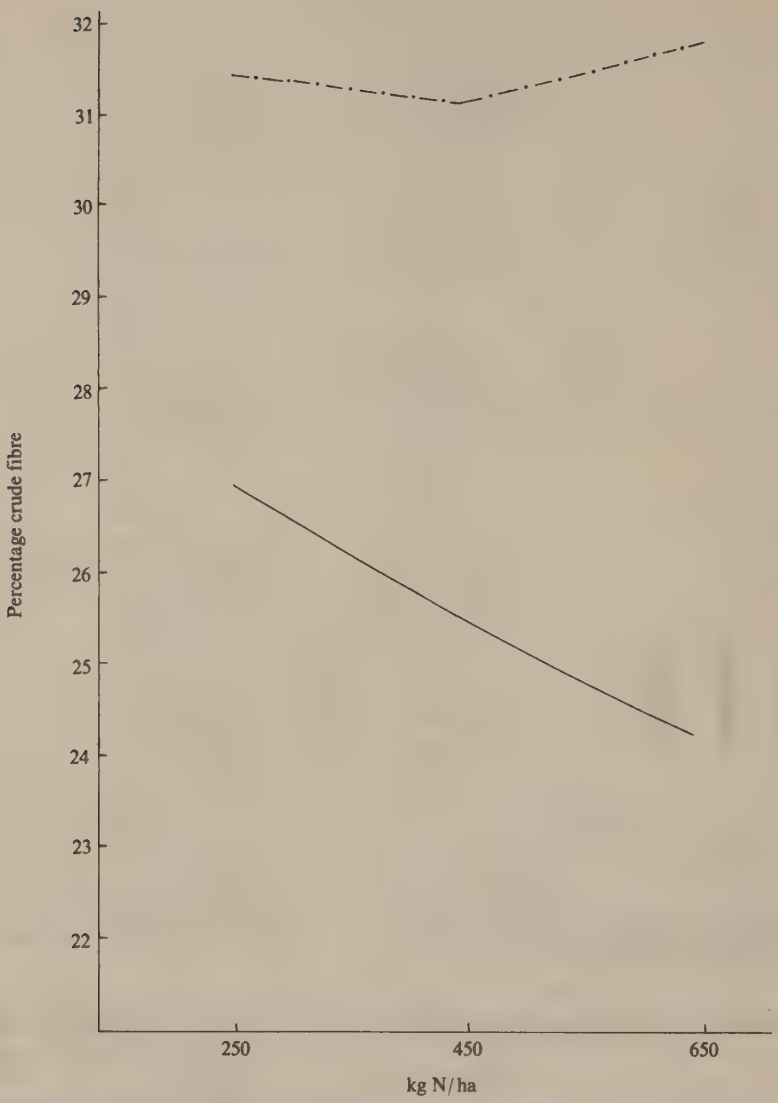

FIG. 4 - Influence of different nitrogen levels on the fibre content of green leaves (–) and stems (–·–)

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Annual Fodder Crops

SMALL GRAIN

POTENTIAL STUDY

N-Ce.143/2: DATA COLLATION FOR ANNUAL FODDER CROPS IN THE NATAL REGION: WINTER CEREALS. 1978-1980.
F.R. Hyam

The purpose of this project was to assess the work done in Natal on annual winter green feed crops of the grass family so that:

1. A comprehensive guide to growing these crops for fodder could be made available for extension and educational purposes in the Natal Region.
2. Functions or norms could be derived from data and used for predicting performance of the crop, and in linear programming of forage flows.
3. Future work needed on these crops could be decided upon without repeating previous work.

These aims have been fulfilled.

Facets covered in the final report are:

1. Classification of cultivar by yield.
2. The quantification of cultivars for use in predictive norms so that interactions between cultivars and other variables can be obtained. This is believed to be unique, and the method offers considerable scope for evaluation of cultivar trials and the prediction of cultivar performance.
3. The provision of predictive norms for determining yields, number of cuts, times of cutting and intervals between cuts.
4. Practical guides to the times and methods of seeding. Methods include depth and rates of seeding. Seed bed preparation methods are also discussed.
5. Fertiliser practices based on soil analysis are given. These are methods proposed by pasture workers in the Natal Region for fertilising annual grass pastures.
6. Weed, pest and disease control.
7. Harvesting and storage.
8. Quality, as measured by protein content, according to time of cutting after planting. For example, repetitive or serial cutting *vs* foggage cuts.

ROOT CROPS

POTENTIAL STUDY

N-Ce.143/3: DATA COLLATION FOR ANNUAL FODDER CROPS IN THE NATAL REGION: CRUCIFEROUS CROPS. 1980-1981
F.R. Hyam

This report summarises available information concerning root crops for fodder purposes. Little work has been done on these crops. The shortage of actual data makes the establishment of norms and recommendations for their management a difficult task, but the relative unimportance of this crop does not warrant a research programme. Some guidelines have been obtained by re-examining available data and publications. Indications have been obtained of the work still required on this group of crops so that growing them can be better advised.

The objective of the project was to assess the root crops as a source of fodder by reviewing available data and published information with a view to:

1.1 Indexing the work for future reference.
1.2 Collating results in a practical guide for use by extension services, farmers and students.
1.3 Providing tentative guidelines from work done elsewhere on problems for which no local answers have been provided.
1.4 Providing, where possible, functions, norms or models for use in predicting performance of crops, and for use in linear programming of forage flows.
1.5 Indicating what information is lacking so that, when priorities permit, further investigations can be made to fill the gaps.

ROOT CROPS

A survey of available data and publications was conducted. The only data available for application were from work done by Van Zyl at Nooitgedacht, by Vorster and others at Kokstad and Tabamhlope, and by Brockett and others at Kokstad. The findings of analyses conducted on available data are included in the appendix to this report. References used in preparing the report and appendices to it are given, and this is seen as sufficient acknowledgement to authors and workers from whom information was drawn.

Owing to the paucity of data relative to other crops such as maize and green feeds, it has not been possible to conduct as deep a study as desirable. Some provisional norms are available though, and these are presented in the appendices.

Data extracted from Agriquest have enabled distribution of the crops by bioclimatic regions to be estimated.

Yield classes were determined. The whole population of total wet yields was divided into two sub-populations, the point of division being the general mean. Means, variances and standard errors of the two sub-populations thus formed were obtained. The variance ratio between these two sub-populations was significant. This indicates that the population is a skew distribution, an observation confirmed by frequency distribution plotted.

In the classification given, the mean yield of the high yielding population was taken as the standardised mean class mark.

Class intervals of 2 x SE/3 were used. The mean of the total, wet, high yielding population was 58 937 kg/ha, the SE being 20 197. The overall, wet yield mean was 32 824 kg/ha. This classification has been used in various ways in the appendix.

A relationship appears to exist between the amount of cold on Japanese radish in its early life and the delaying of bolting to flower. Further investigations in regard to cold sensitivity and bolting are required.

An attempt has been made to provide N, P and K requirement norms based on expected total green yield. Nutrient removal is used in this, and soil status is considered. The soil requirements for maize have been used as a standard on which to commence.

PASTURE UTILISATION RESEARCH: WINTER RAINFALL AREA

Natural Pastures

VELD PASTURES

PHYSIOLOGY

W-Nt.1/6: INFLUENCE OF SEASONAL DEFOLIATON ON THE RESERVES AND DRY MATTER PRODUCTION OF A KAROO SHRUB AND GRASS. 1977-1981
F.G.J. van der Westhuizen

The object of this study was to determine the effect of cutting on photosynthesis, dry matter production, carbohydrate and nitrogen contents of a winter-growing veld grass, *Ehrharta calycina* and a Karoo shrub, *Osteospermum sinuatum*. In one set of experiments 80 % of the aerial parts of the plants was removed when the plants were in the flag leaf stage. (*E. calycina*) or flower bud stage (*O. sinuatum*). In the second experiment 40 % and 80 % , respectively, of the aerial parts of both species were removed at the stage of anthesis. The plants were grown in glasshouses during the winter months when growth usually occurs under natural conditions.

Partial removal of the aerial parts of *O. sinuatum* and *E. calycina* led to significant increases in the photosynthetic efficiency (determined as net carbon dioxide exchange rate) of the leaves present after cutting, except in those cases where too large a portion of the aerial parts was removed. This resulted in a bigger loss of carbon dioxide through the non-photosynthesising material than was absorbed through the photosynthesising material (leaves and sheaths).

From the data obtained it was also evident that when plants of both species were cut at an early stage in their development (flag leaf and bud emergence in this study) they needed a much longer period to regenerate compared to plants cut at the later stage (anthesis). However, since the duration of the beneficial effect of cutting was limited to the earlier growth stages (because of unfavourable climatic conditions at the end of the growing season) the plants that were cut during the earlier growth stages made beter use of the increased photosynthetic efficiency.

Because of the presence of photosynthesising leaf sheaths *E. calycina* proved to be more resistant to

intensive defoliation than *O. sinuatum.*

Partial removal of the aerial parts resulted in a decrease in the sugar and starch concentrations of all the organs of both species. The difference in sugar and starch concentrations between the cut and control plants increased with higher cutting intensities. The reduction in the carbohydrate reserves after cutting that was observed in some cases, demonstrates the role of the carbohydrates as a substrate for energy required for maintenance and regrowth.

Before the end of the experimental period the cut plants of *E. calycina* and *O. sinuatum* succeeded to a large extent in replenishing the sugar and starch concentrations of all their organs to about the same level as those of the control plants. Owing to the fact that those plants of which part of the aerial growth was removed, produced less dry matter during the experimental period than the control plants, the total available carbohydrates of the 80 % treatment especially, were also considerably less.

It was found that the concentration of soluble nitrogen in the plant material was relatively low and that cutting in general had little effect on it. In contrast the trichloroacetic acid precipitated nitrogen concentration, which is a parameter of the protein and non-soluble nitrogen fraction, was more sensitive. Partial removal of the aerial parts resulted in all cases in an increase in the total nitrogen concentration of the stubble leaves of both species. This phenomenon was probably due to the ability of the young leaves which developed after cutting, to produce nitrogen compounds at a higher rate than those of the on average older leaves of the control plants.

A decrease in the nitrogen concentration of the roots of all treatments was measured after cutting. This indicates an inadequate supply of nitrogen compounds from the leaves to the roots.

Cutting has a detrimental effect on dry matter production of both species. This is due to the lack of sufficient capacity during the first year of growth to produce adequate photosynthetic material necessary for a high growth rate.

Plants cut during the late growth stage (anthesis) have smaller mass and carbohydrates and nitrogen reserves at the end of the growing season than those cut earlier (flag leaf and flower bud stage), the reason being the longer time available for regrowth under favourable climatic conditions for the early cut plants.

It is evident that the effect of defoliation on both the Karoo shrub and the veld grass in terms of dry matter production, nitrogen and carbohydrate reserves, can be attributed to the extent to which the photosynthetic capacity of the plants is influenced.

The success of any grazing management system depends on the ability to utilise the pasture in such a way that the plants are able to photosynthesise at optimum levels throughout the growing season.

Perennial Cultivated Pastures

LUCERNE

MANAGEMENT

W-Oh.7/3: LUCERNE PRODUCTION IN THE LITTLE KAROO: GRAZING BY OSTRICHES VERSUS HAY PRODUCTION OF LUCERNE IN THE LITTLE KAROO. 1974-1981
S.A. Barnard

Irrigated lucerne was subjected to the following management practices:

(i) Cutting of hay at 10 % flowering stage.
(ii) A hay cut at 10 % flowering stage followed by a stubble graze by ostriches until all edible material was removed.
(iii) Grazed by ostriches at 10 % flowering stage only.

After the above treatments were carried out twice at the beginning of the season the lucerne was left for a seed yield. The data were collected over four growing seasons.

No significant differences between dry matter yield, seed yield or seed germination were found to exist between the different management practices.

LUCERNE

NUTRITION

W-Oh.7/2: FERTILISATION OF LUCERNE FOR HAY AND SEED PRODUCTION. 1974-1981

S.A. Barnard

To determine if various application levels of P and K had an effect on hay and seed production of lucerne on alkaline soil, a trial was conducted under irrigation at the Oudtshoorn Experimental Farm in the Little Karoo.

Soil samples were analysed and the following fertiliser applications were applied:

O	=	No fertiliser
P_1	=	20 kg P/ha
P_2	=	40 kg P/ha
P_3	=	60 kg P/ha
K_1	=	150 kg K/ha
P_1K_1	=	20 kg P plus 150 kg K/ha
P_2K_1	=	40 kg P plus 150 kg K/ha
P_3K_1	=	60 kg P plus 150 kg K/ha

Over three seasons small differences were found between treatments but these were not significant. The effect of P on seed and hay production was found to be negligible.

Even the application of 300 kg KCl (150 kg)/ha had no effect on hay production. It was found that K had a beneficial effect on seed production. See results below.

Season	Increase (%)
1976	16
1977	11
1978	4

The rise in income because of higher seed production favourably justifies the cost of the single application.

LUCERNE

WATER REQUIREMENTS

W-Oh.7/1: CULTIVATION OF LUCERNE UNDER IRRIGATION IN THE LITTLE KAROO FOR OPTIMAL HAY AND SEED PRODUCTION. 1974-1981

S.A. Barnard and D.J. Beukes

The effects of different levels and timing of flood irrigation were investigated on lucerne on an Oakleaf soil series at Oudtshoorn. The treatments comprised the application of 90, 135 and 180 mm of water as well as the same amounts but in two equal parts during a production period.

Forage yields increased with an increase in the amount of irrigation. Large amounts also were very effective in leaching accumulated salts out of the root zone. The halving of amounts also led to an increase in forage production. The latter increase did not result in an increase in crop water use. However, this irrigation practice led to a serious increase in the salinity and sodium hazard of the soil. Larger forage yields were obtained during the second than first production period. No interaction could be measured between irrigation amount and seed production. The latter was increased when irrigation was applied in two parts.

More roots developed in the 0-600 mm layer under a practice involving small amounts at high frequencies than large amounts at low frequencies. When the frequency was raised for the same amount more roots developed in the deeper layers, i.e. 600-1 400 mm.

Seasonal evapotranspiration (ET_a) varied from 382 mm to 667 mm depending on the amount of irrigation per application. Crop factors (ET_a/E_O) ranged from 0,40 to 0,70 with a peak of 0,99 during the first hay production period for a 180 mm of water application.

Analyses of irrigation water indicated not only dubious quality but also a large seasonal fluctuation thereof.

BOTANICAL RESEARCH

Flora

FLOWERING PLANTS

TAXONOMY

P.J. Vorster: REVISION OF THE TAXONOMY OF *MARISCUS* VAHL AND RELATED GENERA IN SOUTHERN AFRICA.
[Research Project (A)P-Pr.43]
D.Sc.: University of Pretoria. 1978
Supervisor: Prof. Dr P.J. Robbertse

The investigation comprises a revision of the taxonomy of the genus *Mariscus* (fam. Cyperaceae) in the broad sense as it was circumscribed by Podlech (1967). The geographical area covered consists of South Africa, the various homelands which in the past were part of South Africa, South-West Africa, Botswana, Swaziland and Lesotho. The investigation was undertaken because the existing taxonomic accounts of the genus *Mariscus* had become obsolete as a result of new data becoming available, to such an extent that the identification of species became problematic.

The history of the nomenclature of the species which are treated is related in detail. It is shown how the genus *Mariscus* grew with the passage of years, firstly as a result of the discovery of new species, and secondly as species were transferred to *Mariscus* from other genera, mainly *Cyperus*, as the generic concept of *Mariscus* was clearly defined. In the present work 37 species of *Mariscus* are distinguished in southern Africa, of which two are imperfectly known, plus four subspecies and two varieties; and two species of *Courtoisia*, one of *Pseudolipocarpha*, and four species and one subspecies of *Monandrus*.

The study is based primarily on external morphological characteristics, but in addition a scanning electron microscope was used to examine pollen and fruit surfaces, and an anatomical investigation of the roots, basal leaves, bracts of the inflorescence, and primary and secondary peduncles was made.

Characteristics of taxonomic importance are discussed, and an explanation is given of the criteria applied for classification and for establishing the rank of taxa. These are based on the principles formulated by Du Rietz (1930), which are based on evolutionary background as reflected by actual and potential gene-flow between populations.

As a result of the diverging morphology of the material which was studied, it was considered necessary to subdivide the macrogenus *Mariscus* as circumscribed by Podlech (*loc. cit.*) into four separate genera. The genus *Mariscus* sensu stricto was cleared from foreign elements by this process, and consists in southern Africa of perennial hygrophytes to xerophytes with three stamens per flower. The genus *Courtoisia* that was described more than 150 years ago is now re-instated for annual hygrophytes with three stamens per flower and a non-kranz type anatomy. The monotypic genus *Pseudolipocarpha* is described for a species which was originally described in the genus *Lipocarpha* and later transferred to *Mariscus*, and is characterised by being annual and having two stamens per flower and very small floral parts. The new generic name *Monandrus* is established for plants which were already in the past placed in a separate genus, but for which no legitimate generic name was hitherto available. These plants are characterised by being annual with one stamen per flower and excurrent midribs to the glumes.

The genus *Mariscus* is subdivided into five subgenera, mainly on account of the morphology of the basal and underground parts. A variety of additional morphological characteristics could be correlated with this subdivision.

An analysis of the correlation between the different taxonomically significant characteristics supports the naturalness of the classification of the material into genera, and the subdivision of *Mariscus* into subgenera and sections. It also makes it possible to compile a hypothetical evolutionary model for the material which was studied.

Publications

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VORSTER, P.J., 1978. Cyperaceae. The identity and typification of *Kyllinga capensis*. *Bothalia* 12(3), 448.
VORSTER, P.J., 1979. Cyperaceae. A note on *Mariscus sumatrensis*. *Bothalia* 12(4), 634-635.
VORSTER, P.J. *Mariscus* and related genera. In preparation for *Flora sth. Afr.* Vol. 3 Part 1.

NATIONAL HERBARIUM COLLECTIONS

FLOWERING PLANTS

TAXONOMY

L. Hugo: A TAXONOMIC REVISION OF THE SECTION CAMPYLIA OF PELARGONIUM.
[Research Project (A)P-Sb-9]
M.Sc.: University of Stellenbosch. 1981

The last complete revision of the genus *Pelargonium* in 1912 by Knuth divided the genus into 15 sections among which was the section Campylia with seven species and several varieties. His revision was based on gross morphological characters and a very small selection of herbarium material. The purpose of the present work was to study the section Campylia so as to gain a clearer understanding of each species and of the section as a whole by a thorough study of the literature, examination of herbarium specimens from South African as well as overseas herbaria, studies of variation in the field, examination of the anatomy of the leaves and some petals, as well as electron microscope investigations of the pollen, fruit and seed morphology. These last investigations proved to be most useful adjuncts to the basic morphological studies.

The examination of the anatomy of the petiole revealed the following characters which were of use as taxonomic criteria: the occurrence of a central group of vascular bundles, the occurrence of a ring of main bundles interspersed with auxilliary bundles, and the number of bundles in the ring. There were also the conspicuous small epidermal cells which occurred only in some taxa.

The surface sculpturing of the pollen grains can be divided into three groups, namely, reticulate, striped reticulate and an intermediate form. It was found that the size of the grains and the presence of stalagmites were of doubtful taxonomic value.

The surface sculpturing of the seeds was found to fall into two groups. A fine regularly perforated surface occurred in several taxa whereas others possessed a superficial elongate structure above the perforations.

Twelve taxa were recognised and can be identified by means of two keys, one for leaf and vegetative characters and the other for floral characters. *Pelargonium caespitosum* Turcz., which was earlier regarded as a synonym of *P. oenotherae* (L.f.) Jacq., was reinstated as a distinct species. *P. gramineum* H. Bol., formerly a synonym of *P. angustissimum* E. Mey., is now regarded as *P. coronopifolium* Jacq. ssp. *gramineum* (H. Bol.) Hugo ined. *P. ovale* (Burm.f.) Harv. *ovatum* Harv. was placed in synonomy under *P. elegans* (Andr.) Willd. The taxa *P. caespitosum* Turcz. ssp. *concavum* Hugo ined. and *P. ovale* (Burm.f.) L'Hérit. ssp. *hyalinum* Hugo ined. are described for the first time.

The results of this investigation will also be published in *Bothalia*. Eventually they will form part of the Treatment of the Geraniaceae for the Flora of southern Africa.

SCIENTIFIC COLLECTIONS

Research

NATIONAL HERBARIUM COLLECTIONS

TAXONOMY

(A)P-Bm.1: BOTANIC GARDEN OF INDIGENOUS PLANTS. 1945-1981
B. de Winter

The Pretoria National Botanic Garden was established in 1946 on 57 ha of land initially made available by the University of Pretoria. While some land was subsequently lost to the National Roads, the acquisition of additional land on the warm north-facing slopes of the ridge resulted in an overall increase to the present nearly 77 ha. Covering both warm and cool sides of a rocky ridge and its footslopes that run through the east to west length of the Garden, conditions are suitable for cultivating a wide variety of cool as well as frost sensitive indigenous species. In October 1958 the Garden was officially opened by the Minister of the then Department of Agricultural Technical Services, while on 3rd August 1979 the Garden was proclaimed a National Monument.

NATIONAL HERBARIUM COLLECTIONS

The primary objective in the establishment of the Garden is to provide a living collection of indigenous southern African plants for scientific study by staff of the Botanical Research Institute and other scientists. This living plant collection is regarded as an extension and complement to the dried Herbarium collection. It serves also as an introduction centre for indigenous plants of horticultural, medicinal and other economic value. However, the Garden has been laid out and landscaped in a manner that is scientific as well as aesthetically pleasing, so that it also provides educational and recreational facilities to the public. The main subdivisions are on an ecological basis of biomes that are indicative of the principal vegetation types and climatic regions of southern Africa, and include Fynbos, Subtropical Coast Forest, Tropical Lowland Forest, Montane Forest, Afro-alpine Heathland, Grassland, Moist Woodland, Dry Woodland, Savanna and Karoo. In addition, the Garden has a nursery for the propagation of plants for the Garden, glasshouses for special plant collections and experimental areas for taxonomic, economic plant and ecological project studies, and a general decorative plants and water garden area. A Garden records section maintains via a computer based system a complete record of accessions (at present numbering 26 300) to the permanent living plant biome collections and to the experimental plant collections.

Current holdings in the permanent Garden plant collections are already considerable. The cycad (*Encephalartos* spp.) collection of species is virtually complete and more than 400 species of the approximately 700 large tree species found in South Africa are present in the Garden. Of the approximately 20 000 flowering plant species in South Africa, over 4 000 species are in the Garden, together with a large number of plants, mainly succulent species, cultivated for study in the nursery and glasshouse collections.

PLANT PRODUCTION PROMOTION/PLANTPRODUKSIE-BEVORDERING

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OK-Do.61/9: Mielies in die Oos-Kaap: Invloed van plantdatum, cultivar en stikstofbemesting op die opbrengs van mielies te Bathurst (rooiland). 1979. R.S. Marr

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Sg.2/1/1/2/1/2: Evaluasie van kommersieellewensvatbare cultivars vir aanpassingsvermoë.

Sg.2/1/1/2/2/1: Planttydstudies met mieliecultivars.

Sg.2/1/1/2/2/2: Invloed van plantpopulasie en plantdatum op verskillende mieliecultivars.

Sg.2/1/1/2/2/3: Cultivarstudies by verskillende plantpopulasies.

Sg.2/1/1/2/2/4: Cultivargevoeligheid vir grondsuurheid.

Sg.2/1/1/2/3/1: Bewerkingsvereistes op 'n Dovetongrondserie in Natal.

Sg.2/1/1/2/3/2: Bewerkingsvereistes op 'n Msingagrondserie in Natal.

Sg.2/1/1/2/3/3: Bewerkingsvereistes op 'n Leksandgrondserie in Natal.

Sg.2/1/1/2/3/4: Bewerkingsvereistes op 'n Avalongrondserie in Natal.

Sg.2/1/1/2/3/5: Bewerkingsvereistes op 'n Viljoenskroongrondserie in die Noordwes-Vrystaat.

Sg.2/1/1/2/3/6: Bewerkingsvereistes op 'n Bleeksandgrondserie in die Noordwes-Vrystaat.

Sg.2/1/1/2/3/7: Bewerkingsvereistes op 'n Bainsvleigrondserie in die Wes-Transvaal.

Sg.2/1/1/2/3/8: Skeurploegbewerkings op die mieliery van 'n Viljoenskroongrondserie in die Noordwes-Vrystaat.

Sg.2/1/1/2/3/9: Invloed van deklaag-, stoppel- en skoonbewerking op 'n Avalongrondvorm in die Noordwes-Vrystaat.

Sg.2/1/1/2/3/10: Invloed van deklaag-, stoppel- en skoonbewerking op 'n Huttongrondvorm in Suidoos-Transvaal.

Sg.2/1/1/2/4/1: Tegniekontwikkeling vir die evaluasie van cultivars vir onkruiddodersensitiwiteit.

Sg.2/1/1/2/4/2: Chemiese beheer van probleemonkruide in mielies.

Sg.2/1/1/2/4/3: Evaluasie van onkruiddoders vir mielies in Natal.

Sg.2/1/1/2/4/4: Onkruidbeheer by stelsels van verminderde bewerking.

Sg.2/1/1/2/4/5: Onkruidbeheer by stelsel van geen bewerking in mielies.

FISIOLOGIE/PHYSIOLOGY

Sg.2/1/1/3/1/1: Bronverwantskap se invloed op spruitvorming en opbrengs.

Sg.2/1/1/3/1/2: Faktore wat die verwantskap tussen ingeteelde lyne en die kruising beïnvloed ten opsigte van opbrengs, groei en ontwikkeling.

Sg.2/1/1/3/1/3: Invloed van groeireguleerders (Ethrel) op morfologie en ontwikkeling.

SIEKTES/DISEASES

Sg.2/1/1/5/1/1: Monitor van mieliesiektes in produksiegebiede.

Sg.2/1/1/5/2/1: Evaluasie van cultivars en teelmateriaal vir weerstand teen noordelike blaarskroei (*H. turcicum*).

Sg.2/1/1/5/2/2: Evaluasie van cultivars (Fase I) vir weerstand teen suidelike blaarskroei (*H. maydis* ras-T).

Sg.2/1/1/5/2/3: Ondersoek na die belangrikste blaarsiektes by mielies, hul voorkoms en gepaardgaande oesverliese.

Sg.2/1/1/5/3/1: Evaluasie van mieliecultivars en teelmateriaal vir weerstand teen *Ustilago maydis*.

Sg.2/1/1/5/3/2: Evaluasie van cultivars en teelmateriaal vir weerstand teen *Sphacelotheca reiliana*.

Sg.2/1/1/5/4/1: Veldanalise van die voorkoms en belangrikheid van die wortel-, stam- en kopvrotkompleks in die mielieproduksiegebied.

Sg.2/1/1/5/4/2: Taksonomiese studie van die patogene fungusflora van mielies.

PLAE/PESTS

Sg.2/1/1/6/1/1: Identifikasie van ekonomies belangrike grondinsekte by mielies.

Sg.2/1/1/6/1/2: Identifikasie van vektore van mieliesiektes.

Sg.2/1/1/6/2/1: Chemiese bestryding van die mieliestamruspe.

Sg.2/1/1/6/2/2: Meganiese bestryding van die mieliestamruspe.

Sg.2/1/1/6/2/3: Ekologie van die mieliestamruspe.

Sg.2/1/1/6/2/4: Bepaling van 'n ekonomiese skadedrumpel vir die mieliestamruspe.

Sg.2/1/1/6/5/2: Biologie en ekologie van valsdraadwurms.

Sg.2/1/1/6/7/1: Chemiese bestryding van die swartmieliekewer.

Sg.2/1/1/6/7/2: Ekologie van die swartmieliekewer.

Sg.2/1/1/6/8/1: Taksonomie van die genus *Cicadulina* China.

Sg.2/1/1/6/8/2: Ekologie van die genus *Cicadulina* China.

Sg.2/1/1/6/8/3: Bepaling van die ekologiese optima vir die blaarspringer *Cicadulina mbila*.

Sg.2/1/1/6/9/1: Chemiese bestryding van *Tetranychus urticae* Koch.

Sg.2/1/1/6/9/2: Ekologie van *Tetranychus urticae* Koch.

Sg.2/1/1/6/10/1: Chemiese bestryding van aalwurms.

Sg.2/1/1/6/10/2: Seisoenale variasie in aalwurmgetalle.

Sg.2/1/1/6/10/3: Faktore verantwoordelik vir die verspreiding van aalwurms in mielies.

WATERBEHOEFTES/WATER REQUIREMENTS

Sg.2/1/1/7/1/1: Waterbehoeftes van mielies onder besproeiing.

Sg.2/1/1/7/1/2: Verwantskap tussen grond-plant-waterveranderlikes en klimatologiese data vir die opstel van besproeiingskedules.

Sg.2/1/1/7/1/3: Besproeiingsmoontlikhede vir mielies op gronde volgens infiltrasiekapasiteit.

Sg.2/1/1/7/1/4: Invloed van vogpeile op transpirasie en verwelking.

Sg.2/1/1/7/1/5: Invloed van vogstremmings op die fotosintesetempo van mielies by verskillende groeistadia.

Sg.2/1/1/7/1/6: Invloed van vogstremmings op die respirasietempo van mielies by verskillende groeistadia.

GRAANSORGHUM/GRAIN SORGHUM

GEWASKUNDE/CROP SCIENCE

Sg.2/1/2/2/1/1: Introduksie van graansorghumteelmateriaal.

Sg.2/1/2/2/1/2: Evaluasie van nuwe en kommersieellewensvatbare cultivars vir landboukundige en industriële waarde en aanpassingsvermoë.

Sg.2/1/2/2/2/1: Invloed van plantdigtheid en plantdatums op graansorghumcultivars.

Sg.2/1/2/2/2/2: Invloed van rywydte, plantdigtheid en plantdatums op graansorghum.

SIEKTES/DISEASES

Sg.2/1/2/5/2/1: Cultivarevaluasie vir weerstand teen blaarvleksiekte (*Phoma insidiosa*).

Sg.2/1/2/5/2/2: Bestudering van die belangrikheid van saadgedraagde inokulum op sorghumsaailing-blaarvleksiekte en die rol van saadbehandeling om die siekte te beheer.

BOKWIET/BUCKWHEAT

GEWASKUNDE/CROP SCIENCE

Sg.2/1/3/2/1/1: Introduksie van bokwietteelmateriaal.

Sg.2/1/3/2/1/2: Evaluasie van cultivars vir landboukundige, industriële waarde en aanpassingsvermoë.

MANNA/MILLET

GEWASKUNDE/CROP SCIENCE

Sg.2/1/4/2/1/1: Introduksie van *Pennisetum*-teelmateriaal vir graanproduksie.

Sg.2/1/4/2/1/2: Evaluasie van *Pennisetum*-cultivars vir graanproduksie.

Kleingraan/Small Grain

KORING/WHEAT

GEWASKUNDE/CROP SCIENCE

V.5262/30/1/1: Evaluation of crops residue management, soil tillage and weed control practices within specific dryland wheat systems. 1982. C. Engelbrecht

PLAE/PESTS

W-Sb.157/1: Identiteit en voorkoms van plantluise geassosieer met kleingraan. 1977. S.S. Walters

W-Sb.157/2: Plaagstatus van graanplantluise geassosieer met kleingraanverbouing. 1978. S.S. Walters

Proteïen- en Olieryke Sade/Protein and Oil-rich Seeds

GRONDBONE/GROUNDNUTS

VEREDELING/IMPROVEMENT

H-Ps.243/1: Evaluasie van grondboonintroduksie vir gebruik in planteteelt. 1973. P.J.A. van der Merwe

H-Ps.243/2: Genetiese veredeling van grondbone vir droëlandse toestande. 1973. P.J.A. van der Merwe

H-Ps.243/3: Genetiese veredeling van grondbone vir besproeiingsgebiede. 1975. P.J.A. van der Merwe

H-Ps.243/4: Teelt: 'n Ondersoek na die genetiese responsie van grondboonpopulasie as gevolg van indirekte seleksie deur pitgradering. 1977. P.J.A. van der Merwe

GEWASKUNDE/CROP SCIENCE

H-Ps.255/1: Gewaskundige studies oor die invloed van plantdatum by Spaanse tipe grondbone. 1974. C.J. Swanevelder

H-Ps.255/2: Gewaskundige studies oor die invloed van spasiëring by grondbone. 1974. C.J. Swanevelder

H-Ps.255/3: Gewaskundige studies oor die invloed van operding van grondbone. 1974. C.J. Swanevelder

H-Ps.255/4: Gewaskundige studies oor die reproduksiedoeltreffendheid van Spaanse grondbone. 1974. C.J. Swanevelder

H-Ps.255/5: 'n Analise van die groeivermoë van Spaanse grondbone. 1974. C.J. Swanevelder

H-Ps.255/7: Invloed van chemiese blaarvlekbeheer op Spaanse tipe grondbone. 1977. C.J. Swanevelder

H-Ps.259: Evaluasie van grondbooncultivars binne die verbouingsgebied van Suid-Afrika. 1977. C.J. Swanevelder

N-Dd.3/3: Cultivar evaluations at Dundee Research Station. 1962. F.P.C. Blamey

SIEKTES/DISEASES

H-Ps.265/1: Verkenningsondersoeke na peulvrotsiektes by grondbone. 1979. C.J. Swanevelder

DROËBONE

H-Ps.265/2: Studie van spatselvlek (*Phoma arachidicola*) by grondbone met gebruik van elektronmikroskope. 1980. F.M. de Jong

H-Ps.270: Fisiologiese opbrengskomponente by grondbone. 1980. J. Dreyer

VOEDING/NUTRITION

N-Dd.3/11: Calcium, magnesium and sulphur requirements on Avalon soil. 1967. F.P.C. Blamey

SONNEBLOM/SUNFLOWER

VEREDELING/IMPROVEMENT

H-Ps.244/1: Introduksie en evaluasie van sonneblomlyne vir gebruik in 'n teelprogram. 1975. W.J. Vermeulen

H-Ps.244/3: Teling van sonneblomlyne vir bastersaadproduksie. 1975. W.J. Vermeulen

GEWASKUNDE/CROP SCIENCE

H-Ps.269/1: Gewaskundige evaluasie van sonneblomcultivars. 1978. H.L. Loubser

N-Dd.10/1: Sunflower cultivar evaluations at Dundee Research Station. 1974. F.P.C. Blamey

VOEDING/NUTRITION

N-Dd.10/5: N and P fertilisation of sunflowers at Dundee Research Station. 1976. F.P.C. Blamey

SOJABONE/SOYBEANS

GEWASKUNDE/CROP SCIENCE

H-Ps.260/1: Evaluasie van sojabooncultivars in verskillende produksiegebiede. 1978. M.A. Smit

H-Ps.260/2: Gewaskundige karakterisering van stremmingskompensasie by bepaalde en onbepaalde sojabooncultivars. 1979. R. Grant

PLANTVOEDING/PLANT NUTRITION

H-Ps.268/1: Sojaboonproduksie in die Natalstreek: Verbetering van 'n suurgrond. 1980. F.P.C. Blamey

H-Ps.268/2: Sojaboonproduksie in die Natalstreek: Stikstof, fosfor en kalsium - 'n behoefte in Msingakleileem. 1980. F.P.C. Blamey

N-Ce.152/1: Amelioration of an acid soil. 1980. F.P.C. Blamey

N-Ce.152/2: Nitrogen, phosphorus and potassium on a Msinga clay soil. 1980. F.P.C. Blamey

DROËBONE/DRY BEANS

VEREDELING/IMPROVEMENT

H-Ps.238/1: Evaluasie van droëboonintroduksies. 1970. W.J. Vermeulen

H-Ps.238/2: Teling van droëbone vir inmaakdoeleindes. 1970. W.J. Vermeulen

GEWASKUNDE/CROP SCIENCE

H-Ps.262/1: Evaluasie van droëbooncultivars in produksiegebiede. 1978. A.J. Liebenberg

LUPIENE/LUPINS

VEREDELING/IMPROVEMENT

W-Wg.4: Lupienteelt. 1943. K.W. Pakendorf

GEWASKUNDE/CROP SCIENCE

W-Lg.9: Evaluasie van lupiencultivars. 1958. J.E. Wicht

Ander Akkerbougewasse/Other Agronomic Crops

KATOEN/COTTON

VEREDELING/IMPROVEMENT

T-Lk.2/1: Katoenteling en -seleksie. 1974. H.G. van Heerden

T-Lk.2/2: Introduksie van katoenlyne en -cultivars uit die buiteland. 1974. H.G. van Heerden

T-Lk.2/5: Terugkruisings by katoen. 1963. H.G. van Heerden

GEWASKUNDE/CROP SCIENCE

T-Lk.2/6: Katoenopbrengsproewe. 1971. H.G. van Heerden

T-Lk.2/7: Katoencultivarproewe. 1960. H.G. van Heerden

T-Lk.2/4: Nasionale katoencultivarproewe. 1975. H.G. van Heerden

VOEDING/NUTRITION

(S)T.318: Reaksie van katoen op stikstoftoediening met blaarontledings as diagnostiese hulpmiddel. 1980. M.C. Dippenaar

WATERBEHOEFTES/WATER REQUIREMENTS

T-Bt.11/1: Uitwerking van grondvogvariasie op opbrengs. 1966. M.C. Dippenaar

T-Lk.3/1: Invloed van vogtekorte tydens verskillende groeiperiodes op katoen. 1977. M.C. Dippenaar

PLAE/PESTS

T-Lk.5/1: Faktore wat die beheer van rooispinmyte met sistemiese mytmiddels beïnvloed. 1979. D.P. de Beer

T-Lk.5/2: Evaluasie en biologie van predatore met die oog op geïntegreerde beheer van rooispinmyte. 1979. D.P. de Beer

TABAK/TOBACCO

VEREDELING/IMPROVEMENT

(S)T.128/1: Teelwaardebepaling van donker lugdroogtabak. 1964. M.P. Lamprecht

TABAK

(S)T.128/2: Teelwaardebepaling van oonddroogtabak. 1964. M.P. Lamprecht

(S)T.128/3: Teelwaardebepaling van ligte lugdroogtabak. 1967. M.P. Lamprecht

(S)T.128/4: Teelwaardebepaling van burleytabak. 1969. M.P. Lamprecht

(S)T.128/6: Gebruik van haploïede plante in tabakteling. 1976. M.P. Lamprecht

(S)T.113: Inteling van die manlike steriliteitsfaktor in sommige *Nicotiana tabacum*-cultivars. 1956. A.P.F. Cornelissen

(S)T.128/5: Teling van *Nicotiana tabacum*-cultivars wat weerstandbiedend is teen siektes. 1952. M.P. Lamprecht, G.C. Prinsloo

(S)T.111: Teling van *Nicotiana tabacum*-cultivars wat weerstandbiedend of immuun is teen knopwortelnematodes. 1956. A.P.F. Cornelissen

GEWASKUNDE/CROP SCIENCE

(S)T.109/1: Cultivarproewe met oonddroogtabak. 1966. M.P. Lamprecht

(S)T.109/2: Cultivarproewe met donker lugdroogtabak. 1966. M.P. Lamprecht

(S)T.109/3: Cultivarproewe met ligte lugdroogtabak. 1966. M.P. Lamprecht

(S)T.109/4: Cultivarproewe met burleytabak. 1966. M.P. Lamprecht

(S)T.109/6: Cultivarproewe met oriëntale tabak. 1958. W.J.C. v.d. Merwe

(S)T.129/1: Spasiëring en top van oonddroogtabak. 1966. M.P. Lamprecht

(S)T.129/2: Spasiëring en top van ligte lugdroogtabak. 1966. M.P. Lamprecht

(S)T.129/3: Spasiëring en top van donker lugdroogtabak. 1966. M.P. Lamprecht

(S)T.129/4: Spasiëring en top van burleytabak. 1966. M.P. Lamprecht

(S)T.132/1: Doeltreffendheid van chemiese suierbeheermiddels op tabak. 1968. M.P. Lamprecht

(S)T.133/1: Doeltreffendheid van chemiese onkruidbeheer in tabakaanplantings. 1968. M.P. Lamprecht

(S)T.135/1: Verbouing van tabak direk na koring onder besproeiing. 1976. M.P. Lamprecht

VOEDING/NUTRITION

(S)T.20/12: Stikstofindekse vir en stikstoflewering van tabakproduserende gronde en in besonder die Arcadiaserie. 1972. W.J. Pienaar, H.J. Boshoff

(S)T.20/14: Spoorelementvoeding van tabak. 1973. W.J. Pienaar, H.J. Boshoff

(S)T.20/15: Opname van die verwantskap tussen die voedingselementstatus van gronde en die samestelling en opbrengs van tabak. 1973. W.J. Pienaar, H.J. Boshoff

WATERBEHOEFTES/WATER REQUIREMENTS

(S)T.131/3: Invloed van vloed- en sprinkelbesproeiing op die opbrengs en kwaliteit van oonddroogtabak. 1968. M.P. Lamprecht

(S)T.131/6: Besproeiingspraktyke vir vestiging van tabakplantjies op kleigrondwalle. 1976. M.P. Lamprecht

SIEKTES/DISEASES

(S)T.306/1: Swartwortelvrot van tabak en die beheer daarvan. 1977. G.C. Prinsloo

(S)T.317/1: Interaksies tussen *Phytophthora nicotianae* var. *nicotianae* en ander grondgedraagde organismes. 1977. G.C. Prinsloo

(S)T.317/2: Invloed van wisselbou op die populasie van *Phytophthora nicotianae* var *nicotianae*, in die grond. 1977. D.A. de Villiers

(S)T.306/2: Moontlike alternatiewe gashere vir die swam *Thielaviopsis basicola*. 1980. D.A. de Villiers

(S)T.306/3: Chemiese beheer van *Thielaviopsis basicola*. 1980. G.C. Prinsloo

(S)T.317/3: Chemiese beheer van *Phytophthora nicotianae* var. *nicotianae*. 1980. G.C. Prinsloo

(S)T.316: Voorkoms en beheer van tabaksiektes wat gedurende sekere seisoene van belang kan wees. 1973. R.J. van Wyk

PLAE/PESTS

(S)T.204/2: Chemiese beheer van nematodes in tabaksaadbeddings. 1959. R.J. van Wyk

(S)T.208/2: Chemiese beheer van die sigaretkewer, *Lasioderma serricorne*, in tabakskure. 1969. E.G. Eulitz

(S)T.209: Voorkoms en beheer van tabakinsekte wat gedurende sekere seisoene van belang kan wees. 1973. E.G. Eulitz

CHEMIE-FISIKA/CHEMISTRY-PHYSICS

(S)T.310/1: Skeiding, identifikasie en kwantitatiewe bepaling van tabakrookkomponente. 1965. J.G. Nel

(S)T.310/2: Fisiese en chemiese eienskappe van blaartabak en die invloed daarvan op blaarkwaliteit en rooksamestelling. 1965. J.G. Nel

(S)T.310/3: Invloed van verbouings- en prosesseringsgeskiedenis van tabak op die samestelling van die blad en rook. 1965. J.G. Nel

(S)T.315/1: Afbreking van residu's van insekbeheermiddels op tabak. 1969. E.G. Eulitz

DIVERSE AKKERBOUGEWASSE/SUNDRY AGRONOMIC CROPS

GEWASKUNDE/CROP SCIENCE

OK-Bh.7/2: Sigorei in die Oos-Kaap: cultivarproewe. 1974. J.D. Aucamp

OK-Bh.7/7: Sigorei in die Oos-Kaap: plant- en oesdatum vir sigorei op 'n Oakleaf Limpopo. 1978. J.D. Aucamp

OK-Bh.7/8 Sigorei in die Oos-Kaap: die invloed van voorafgaande gewasse op die opbrengs van sigorei. 1980. J.D. Aucamp

VOEDING/NUTRITION

OK-Bh.7/9: Sigorei in die Oos-Kaap: Die bemesting van sigorei op 'n Oakleaf Limpopo. 1980. J.D. Aucamp

ONKRUIDBEHEER/WEED CONTROL

OK-Bh.7/4: Sigorei in die Oos-Kaap: onkruiddoders. 1974. J.D. Aucamp

VEREDELING/IMPROVEMENT

OK-Bh.7/3: Sigorei in die Oos-Kaap: saadproduksie en seleksie. 1974. J.D. Aucamp

RYS/RICE

GEWASKUNDE/CROP SCIENCE

Sg.2/1/5/2/1/1: Introduksie van rysteelmateriaal.

Sg.2/1/5/2/1/2: Evaluasie van cultivars vir landboukundige waarde en aanpassingsvermoë.

TUINBOUNAVORSING/HORTICULTURAL RESEARCH

Knolgewasse/Tuber Crops

AARTAPPELS/POTATOES

VEREDELING/IMPROVEMENT

(A)T-Rp.172: Aartappelteling. 1963. F.I. du Plooy, A.F. Visser

(A)T-Rp.175: Genetiese studies by aartappels. 1975. F.I. du Plooy, A.F. Visser

GEWASKUNDE/CROP SCIENCE

(A)T-Rp.171: Aartappelcultivarproewe. 1963. F.I. du Plooy, A.F. Visser

(A)T-Rp.205: Aartappelcultivarevaluasie in die Winterreënstreek. 1973. A. Agenbag

(A)T-Rp.169: Aartappelcultivarevaluasie in Natal. 1977. R.D. Mould

(A)T-Rp.174: Introduksie en evaluasie van buitelandse aartappelcultivars. 1975. F.I. du Plooy, A.F. Visser

(A)T-Rp.173: Invloed van plantdatum op aartappelproduksie in verskillende gebiede. 1972. K.P. Prinsloo, G.J.J. Lubbe, G.S. Cloete

(A)T-Rp.167: Invloed van plantdatum op aartappelproduksie in die Kouebokkeveld. 1981. A. Agenbag

(A)T-Rp.190: Spruitstimulerende middels ter verbreking van die knolrusperiode. 1978. K.P. Prinsloo

(A)T-Rp.192: Verdraagsaamheid van verskillende aartappelcultivars teenoor vooropkoms-toedienings van metribusin. 1978. G.J.J. Lubbe

(A)T-Rp.193: Bestandheid van besproeide BP1-aartappels op verskillende groeistadia teenoor metribusin op sanderige kleileemgrond. 1978. G.J.J. Lubbe

(A)T-Rp.194: Invloed van plant- en bemestingstegnieke op aartappelproduksie te Glen. 1979. G.S. Cloete

(A)T-Rp.195: Invloed van moergrootte en plantpatroon op aartappelproduksie te Sandvet. 1980. G.S. Cloete

PLANTVOEDING/PLANT NUTRITION

(A)T-Rp.199: Bemestingsbehoeftes van aartappels op verskillende grondtipes en onder verskillende klimaatstoestande. 1980. G.J.J. Lubbe

(A)T-Rp.170: Bemestingstudies met aartappels in Natal. 1977. R.D. Mould

WATERBEHOEFTE/WATER REQUIREMENT

(A)T-Rp.168: Effek van besproeiingsintensiteite op die opbrengs van aartappelcultivars. 1977. R.D. Mould

SIEKTES/DISEASES

(A)T-Rp.186: Voorspelling van aartappellaatroesepidemies in Transvaal. 1972. A.C. Jandrell

(A)T-Rp.187: Studie en beheer van bruinskurf (*Streptomyces scabies).* 1978. B.W. Young

(A)T-Rp.188: Chemiese beheer van *Fusarium*-droëvrot. 1980. A.C. Jandrell

(A)T-Rp.189: Ekologie en beheer van swartskurf (*Rhizoctonia solani*). 1979. B.W. Young

(A)T-Rp.177: Opsporing en identifikasie van aartappelvirussiektes. 1974. P.J. Prins, J.D. Snyman

(A)T-Rp.179: Uitskakeling van aartappelvirusse deur middel van hittebehandeling en weefselkultuur. 1977. J.L.F. Dutrieux

(A)T-Rp.180: Mobiliteit van die rolbladvirus in verskillende aartappelcultivars. 1980. J.L.F. Dutrieux

(A)T-Rp.182: Studie van die plantluisviruskompleks en moerproduksie. 1978. D.C.A. Hoffman

(A)T-Rp.183: Gedrag van bladrolvirus by verskillende aartappelcultivars. 1980. D.C.A. Hoffman

(A)T-Rp.184: Invloed van aartappelvirus X op aartappelcultivars. 1980. J.L.F. Dutrieux

PLAE/PESTS

(A)T-Rp.200: Beheer van snywurms (hoofsaaklik *Euxoa segeteum*). 1977. H. Steenekamp

(A)T-Rp.201: Beheer van swartmieliekewers by aartappels. 1978. A. Barnard

(A)T-Rp.202: Bio-ekologiese studies van die swartmieliekewer. 1979. H. Gouse

(A)T-Rp.203: Bio-ekologiese studies op die aartappelsnuitkewer (*Sciobius horni* Marshall) en doeltreffende beheer. 1979. H. Steenekamp

(A)T-Rp.204: Beheer van aartappelmot (*Phthorimaea operculella* Zeller) op opgebergde aartappels. 1979. H. Steenekamp

(A)T-Rp.178: Vlugpatrone, heersende winde en bronne van luise met die oog op 'n voorspellingsdiens vir moerproduksie. 1977. H. Steenekamp

(A)T-Rp.181: Migrasiegewoontes van die plantluisvektore van aartappelvirusse in die verskillende saadaartappelproduserende gebiede van die Vrystaatstreek. 1978. T.C. Botha

(A)T-Rp.206: Migrasiegewoontes van plantluisvektore van aartappelvirusse in die verskillende aartappelmoerproduserende gebiede van die Winterreënstreek. 1976. S.S. Walters

(A)T-Rp.185: Ondersoek na die penetrasie van sistemiese insektisides in aartappelplante vir die beheer van virusvektore. 1979. T.C. Botha

Groente/Vegetables

TAMATIES/TOMATOES

VEREDELING/IMPROVEMENT

(A)T-Rp.148/1/1: Teling en seleksie van varsmarktamaties. 1975. E. Aucamp

(A)T-Rp.148/1/2: Teling en seleksie van inmaaktamaties. 1975. E. Aucamp

GEWASKUNDE/CROP SCIENCE

(A)T-Rp.148/2/1: Evaluasie van nuwe varsmarktamatiecultivars en teellyne vir aanpasbaarheid in die verskillende produksiegebiede. 1975. S.E. Bosch

(A)T-Rp.148/2/2: Evaluasie van die nuwe inmaaktamatiecultivars en teellyne vir aanpasbaarheid in die verskillende produksiegebiede. 1978. S.E. Bosch

(A)T-Rp.148/3/1: Produksie van tamaties onder beskerming. 1975

SIEKTES/DISEASES

(A)T-Rp.148/5/1: Swamdodertoetse teen swamsiektes en ondersoek na onbekende siektes by tamaties wat 'n bedreiging vir oeste is. 1975. B.H. Boelema

(A)T-Rp.148/5/3: Epidemiologie van *Verticillium*-verwelksiekte van tamaties. 1975. S. Visser

(A)T-Rp.148/5/2: Toetsing van plantmateriaal van die genus *Lycopersicon* vir bestandheid teen bakteriese kanker. 1975. B.H. Boelema

(A)T-Rp.160/1: Virussiektes van tamaties. 1976. P. Grotenhuis

BLOMKOOL/CAULIFLOWER

VEREDELING/IMPROVEMENT

(A)T-Rp.153/1/1: Teling en seleksie van blomkool. 1976. A.F. Coertze

GEWASKUNDE/CROP SCIENCE

(A)T-Rp.153/2/1: Evaluering in verskillende gebiede van blomkoolcultivars. 1977. A.F. Coertze

KOPKOOL/CABBAGE

VEREDELING/IMPROVEMENT

(A)T-Rp.153/1/1: Teling en seleksie van kopkool. 1979. A.F. Coertze

GEWASKUNDE/CROP SCIENCE

(A)T-Rp.153/2/2: Evaluering in verskillende gebiede van kopkoolcultivars. 1976. O.J. Olivier

UIE/ONIONS

VEREDELING/IMPROVEMENT

(A)T-Rp.157/1/1: Teling en seleksie van uie. 1976. O.J. Olivier

GEWASKUNDE/CROP SCIENCE

(A)T-Rp.157/2/1: Evaluasie van uiecultivars in produksiegebiede. 1977. O.J. Olivier

PATATS/SWEET POTATOES

VEREDELING/IMPROVEMENT

(A)T-Rp.152/1/1: Teling en seleksie van patats. 1976. C.P. du Plooy

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(A)T-Rp.152/2/1: Evaluasie van patatcultivars in verskillende gebiede. 1976. C.P. du Plooy

SWEET POTATOES

SIEKTES/DISEASES

(A)T-Rp.160/1: Virussiektes van patats. 1976. C. Thompson

BOONTJIES/BEANS

VEREDELING/IMPROVEMENT

(A)T-Rp.155/1/1: Teling van groenbone. 1976. A.F. Coertze

GEWASKUNDE/CROP SCIENCE

(A)T-Rp.155/2/1: Evaluering van nuwe cultivars en teellyne van groenbone in die produksiegebiede. 1977. A.F. Coertze

(A)T-Rp.155/3/1: Spasiëringstudies met groenbone. 1977. A.F. Coertze

SIEKTES/DISEASES

(A)T-Rp.155/4/1: Studie van vetvleksiekte van groenbone en die bepaling van bestandheid daarteen. 1975. B.H. Boelema

(A)T-Rp.160/1: Virussiektes van groenbone. 1978. P. Grotenhuis

ERTJIES/PEAS

VEREDELING/IMPROVEMENT

(A)T-Rp.154/1: Teling van groenerte. 1976. S.E. Bosch

(A)T-Rp.154/1: Teling van droë-erte. 1976. S.E. Bosch

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(A)T-Rp.154/2: Evaluering van nuwe cultivars en teellyne van groen-erte in die produksiegebiede. 1976. S.E. Bosch

(A)T-Rp.154/2: Evaluering van nuwe cultivars en teellyne van droë-erte in die produksiegebiede. 1976. S.E. Bosch

SIEKTES/DISEASES

(A)T-Rp.160/1: Virussiektes van erte. 1977. P. Grotenhuis

PAMPOENE/PUMPKINS

VEREDELING/IMPROVEMENT

(A)T-Rp.156/1/2: Teling en seleksie van pampoene. 1976. S.E. Bosch

GEWASKUNDE/CROP SCIENCE

(A)T-Rp.156/2/1: Evaluasie van pampoencultivars in verskillende produksiegebiede. 1977. S.E. Bosch

SIEKTES/DISEASES

(A)T-Rp.160/1: Virussiektes van pampoene. 1977. F. Reysenbach

SPANSPEKKE/SWEET MELONS

VEREDELING/IMPROVEMENT

(A)T-Rp.156/1/1: Teling en seleksie van spanspekke. 1976. J.J.B. van Zijl

GEWASKUNDE/CROP SCIENCE

(A)T-Rp.156/2/1: Evaluasie van spanspekcultivars in verskillende produksiegebiede. 1976. J.J.B. van Zijl

DIVERSE GROENTE/SUNDRY VEGETABLES

GEWASKUNDE/CROP SCIENCE

(A)T-Rp.157/2/1: Verbouingstudies met knoffel. 1978. O.J. Olivier

TB.2427/30/2/1: Chemical weed control studies on garlic. 1981. P.F. Nortjé

Blomme en Sierplante/Flowers and Ornamentals

LACHENALIA

VEREDELING/IMPROVEMENT

(A)T-Rp.150/1/1: Veredeling van die genus *Lachenalia*. 1976. J. Lubbinge

SIEKTES/DISEASES

(A)T-Rp.150/4/1: Diagnostiese ondersoek na nuwe siektes by *Lachenalia*. 1976. B.H. Boelema

(A)T-Rp.150/4/2: Virussiektes van *Lachenalia*. 1979. G. Thompson

ORNITHOGALUM

VEREDELING/IMPROVEMENT

(A)T-Rp.150/1/2: Veredeling van die genus *Ornithogalum*. 1979. J. Lubbinge

SIEKTES/DISEASES

(A)T-Rp.150/4/1: Diagnose van nuwe siektes by *Ornithogalum*. 1976. S. Visser

(A)T-Rp.150/4/2: Virussiektes van *Ornithogalum* in Suid-Afrika. 1978. G. Thompson

GEWASKUNDE/CROP SCIENCE

(A)T-Rp.150/2/1: Gewaskundige manipulasie van die gewas om die blom- en groeiperiode te verander. 1979. D. Ferreira

ROSE/ROSES

SIEKTES/DISEASES

(A)T-Rp.159/1: Virussiektes van rose. 1979. P.J. Klesser

(A)T-Rp.158/1/2: Simptome en ontwikkeling van *Verticillium*-verwelksiekte by rose. 1979. S. Visser

GEWASKUNDE/CROP SCIENCE

(A)T-Rp.158/3: Affiniteitstudies met rose. 1977. D. Ferreira

(A)T-Rp.158/4: Opberging en na-oes- fisiologiese studies met rose. 1975. D. Ferreira

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VEREDELING/IMPROVEMENT

(A)T-Rp.150/1/3: Veredeling van die genus *Gladiolus*. 1978. J. Lubbinge

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(A)T-Rp.150/4/1: Diagnostiese ondersoek na nuwe siektes by *Gladiolus*. 1976. S. Visser

(A)T-Rp.150/4/2: Virussiektes van *Gladiolus* in Suid-Afrika. 1976. G. Thompson

PROTEAS

TAKSONOMIE/TAXONOMY

(A)T-Rp.149/1: Identifisering en beskrywing van Proteaceae-spesies. 1977. G. Brits

(A)T-Rp.149/6: Registrasie van nuwe cultivars vir vrystelling aan die bedryf. 1978. G. Brits

GEWASKUNDE/CROP SCIENCE

(A)T-Rp.149/2: Versameling, vestiging en instandhouding van proteanavorsingsmateriaal. 1977. M. van Niekerk

(A)T-Rp.149/6: Evaluasie van nuwe proteacultivars en -seleksies. 1977. M. van Niekerk

(A)T-Rp.149/3/2: Proteas: voortplanting deur saad. 1977. G. Brits

(A)T-Rp.149/3/1: Proteas: vegetatiewe voortplanting. 1977. G. Brits

(A)T-Rp.149/4: Proteas: verbouing in boorde. 1977. M. van Niekerk

VEREDELING/IMPROVEMENT

(A)T-Rp.149/5: Proteas: veredeling. 1977. G. Brits

PLAE/PESTS

(A)T-Rp.149/7: Beheer van die plae wat proteas aanval. 1977. D. Rust

DIVERSE BLOMME/SUNDRY FLOWERS

SIEKTES/DISEASES

(A)T-Rp.158/1/1: Diagnose van nuwe siektes en middels vir die beheer van siektes by diverse blomplante. 1976. C. Sharpe

(A)T-Rp.159/1: Virussiektes van diverse blomplante. 1977. S. Watermeyer

DIVERSE SIERPLANTE/SUNDRY ORNAMENTALS

SIEKTES/DISEASES

(A)T-Rp.158/1/1: Diagnose van nuwe siektes en middels vir die beheer van siektes by diverse sierplante.

PLAE/PESTS

(A)T-Rp.158/2/1: Diagnose van plae en evaluering van beheermiddels vir diverse sierplante. 1977. M.C. Bolton

(A)T-Rp.158/2/2: Scarabaeidae: opname van populasies wat voorkom op diverse sierplante. 1977. J. MacDonald

(A)T-Rp.158/2/3: Beheertegnieke vir Scarabaeidae op diverse sierplante. 1977. J. MacDonald

Kern- en Steenvrugte/Pome and Stone Fruit

APPELS/APPLES

VEREDELING/IMPROVEMENT

(S)WP.227/1: Teel van 'n laat rooi appelcultivar. 1977. R.E. Pieterse

(S)WP.227/2: Teel van appelcultivars bestand teen skurfsiekte. 1977. N. Hurter, M.J. van Tonder

(S)WP.227/3: Teel van Granny Smith-tipe appel met kompakte groeiwyse. 1977. N. Hurter, M.J. van Tonder

(S)WP.227/4: Ontwikkeling van weefselkultuurtegnieke met die oog op die bevordering van mutasieteelt by appels. 1978. R.E. Pieterse

(S)WP.227/5: Teel van appelcultivars met kompakte groeiwyse. N. Hurter, M.J. van Tonder

GEWASKUNDE/CROP SCIENCE

(S)WP.249/5: Aanplanting en instandhouding van appelcultivars. 1970. J.V. Hadlow

(S)WP.249/1: Tweede fase-evaluering van appelcultivars in Wes-Kaap en Langkloof. 1971. P.R. Jolly

(S)WP.249/7: Evaluasie van Red Delicious-appeltipes. 1978. P.R. Jolly

(S)WP.249/8: Evaluasie van Golden Delicious-appeltipes. 1978. P.R. Jolly

(S)WP.249/3: Evaluasie van 'n aantal ingevoerde appelonderstamme. 1971. O. Bergh

(S)WP.250/1: Vergelyking van opleistelsels in Elgin-omgewing. 1969. O. Bergh

(S)WP.250/2: Snoei van nougeplante bome. 1972. O. Bergh

(S)WP.250/3: Opleistelsels vir bome op dwergende onderstamme. 1972. O. Bergh

PLANTVOEDING/PLANT NUTRITION

(S)WP.229/7: Grondvoorbereiding vir appelbome in die Langkloof. 1972. G.K. Schliemann

(S)WP.229/5: Grondvoorbereiding vir appelbome met kompos. 1972. G.K. Schliemann

(S)WP.229/6: Evaluasie van munisipale kompos. 1971. G.K. Schliemann

(S)WP.229/1: Kaliumvoorsieningsvermoë van boordgronde. 1977. J. Woolridge

(S)WP.229/2: Omsetting en vervlugtiging van stikstofvorme in grond. 1977. M. du Preez

(S)WP.229/10: Demonstrasie-bemestingsproewe in appelboorde. 1973. J.H. Terblanche

(S)WP.229/4: Kartering van NIVV-proefplaasgronde. 1971. J. Woolridge

WATERBEHOEFTES/WATER REQUIREMENTS

(S)WP.254/3: Grondvogverspreiding onder drupbesproeiing. 1975. F.C. van Rooyen

SIEKTES/DISEASES

(S)WP.189/6: Kernverrotting by Starking-appels. 1979. J.C. Combrink

PLAE/PESTS

(S)WP.236/3: 'n Monitorstelsel vir bladrollers in appelboorde. 1977. T.L. Blomefield, K.L. Pringle

(S)WP.234/2: Chemiese beheer van kodlingmot in appelboorde. 1977. T.L. Blomefield, P.L. Swart

(S)WP.265/1: Opname van verskillende nematodespesies wat in die Wes-Kaaplandse appelboorde voorkom. 1979. H.J. Hugo

(S)WP.265/2: Chemiese beheer van nematodes in appelboorde. 1980. H.J. Hugo

WEERKUNDESTUDIES/METEOROLOGICAL STUDIES

(S)WP.179/12: Voorkoming van sonbrand by appels. 1980. O. Bergh

(S)WP.254/4: Oorhoofse verkoeling van appels. 1979. F.C. van Rooyen

FISIOLOGIE/PHYSIOLOGY

VV.2441/03/2/3: A test for the occurrence of specific replant disease of apples. 1982. H.J. van Zyl

(S)WP.255/1: Invloed van ioonbalans op opname en vervoer van kalsium in appelbome. 1977. W.A.G. Kotzé

(S)WP.232/1: Bepaling van die regte pluktyd by appels. 1978. A.B. Truter

(S)WP.247/1: Kalsiumdoopbehandelings vir die beheer van bitterpit by appels. 1976. T.R. Visagie

(S)WP.229/3: Grondkundige en plantkundige faktore wat bitterpit by appels beïnvloed. 1976. J.H. Terblanche

OESHANTERING/HANDLING OF THE CROP

(S)WP.253/1: Invloed van gassamestelling tydens beheerde atmosfeeropberging op houvermoë van appels. 1978. A.B. Truter

(S)WP.247/3: Faktore wat kneusing by Golden Delicious-appels induseer. 1979. G.J. Eksteen

CHEMIES-FISIESE ONTLEDINGSTUDIES IN APPELBOORDGRONDE/CHEMICAL-PHYSICAL ANALYSIS OF APPLE ORCHARD SOILS

(S)WP.223/1: Aanwending van selektiewe ioonelektrodes vir kwantitatiewe bepaling van voedingstowwe in appelboordgronde. 1977. J.J.A. Bester

(S)WP. 229/1: Kaliumvoorsieningsvermoë van appelboordgronde. 1977. J. Woolridge

(S)WP. 229/2: Omsetting en vervlugtiging van stikstofbronne in appelboordgronde. 1977. M. du Preez

PERE/PEARS

VEREDELING/IMPROVEMENT

(S)WP.226/1: Teel van laat peercultivars wat vroeg in drag kom. 1977. P.F. Louw

(S)WP.226/2: Teel van peercultivars bestand teen skurfsiekte. 1977. P.F. Louw

(S)WP.226/3: Teel van 'n Packham's Triumph-tipe peer met kompakte groeiwyse. 1977. R.E. Pieterse

GEWASKUNDE/CROP SCIENCE

(S)WP.249/6: Aanplanting en instandhouding van peercultivars. 1970. J.W. Etsebeth

(S)WP.249/2: Tweede fase-evaluasie van peercultivars in die Winterreënvalgebied. 1971. H.J. van Zyl

(S)WP.249/4: Evaluasie van peeronderstamme in die Winterreënvalgebied. 1971. H.J. van Zyl

(S)WP.250/6: Verhoging van produksie by pere. 1978. H.J. van Zyl

(S)WP.239/2: Beworteling van BP2-peeronderstam. 1978. P. van Huyssteen

FISIOLOGIE/PHYSIOLOGY

(S)WP.239/1: Invloed van virussiektes op prestasie van peercultivars. 1972. H.J. van Zyl

TEGNOLOGIE/TECHNOLOGY

(S)WP.238/3: Verwerking van peerafval na sap. 1978. C.F. Hansmann

(S)WP.238/4: Tekstuur van ingemaakte pere. 1978. J.A.G. van Rhyn

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PERSKES/PEACHES

VEREDELING/IMPROVEMENT

(S)WP.186/1: Teel van perskecultivars vir inmaak. 1971. N. Hurter, P.F. Louw

(S)WP.186/2: Teel van geelvleisperskecultivars geskik vir droog en dessert. 1972. N. Hurter, P.F. Louw

(S)WP.186/3: Mutasieteelt van kaalperskes aan die hand van bestraling. 1979. P.F. Louw

(A)T-Rp.161/1: Teling en seleksie van perskes. 1976. E.P. Evans

GEWASKUNDE/CROP SCIENCE

(S)WP.251/7: Aanplanting en instandhouding van perskecultivars. 1970. J.W. Etsebeth

(S)WP.251/1: Tweede fase-evaluasie van perskecultivars in Wes-Kaap. 1971. J.D. Stadler

(S)WP.251/4: Evaluasie van vyf perskeonderstamme te Robertsonproefplaas. 1971. O. Bergh

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(A)T-Rp.161/2/2: Evaluasie van nuwe prosesseringsperskecultivars en teellyne. 1978. E.P. Evans

(A)T-Rp.161/3/2: Optimale plantafstande en verbouingspraktyke vir perskes in hoëdigtheidplant-stelsels. 1975. T. Haulik

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WATERBEHOEFTE/WATER REQUIREMENT

(S)WP.262/1: Lisimeterstudies met perskes. 1979. H. Tormann

SIEKTES/DISEASES

(S)WP.257/4: Beheer van kroongal by perskes: biotipes van *Agrobacterium tumefaciens* en *A. radiobacter* in R.S.A. 1978. H.J. du Plessis

PLAE/PESTS

(S)WP.233/1: Monitorstelsel vir valskodlingmot by perskes. 1977. T.L. Blomefield

(A)T-Rp.161/4/1: Biologiese en ekologiese opname van die valskodlingmot op perskes in die somerreëngebied. 1975. C.C. Daiber

TEGNOLOGIE/TECHNOLOGY

(S)WP.237/1: Rypheid van taaipitperskes vir inmaak. 1977. J.C.D. Theron, B.K. Nortjé

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CHEMIES-FISIESE ONTLEDINGS/CHEMICAL-PHYSICAL ANALYSIS

(S)WP.151/3: Minerale, suiker- en vitamiensamestelling van taaipitperskes. 1974. B.K. Nortjé

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PRUIME/PLUMS

VEREDELING/IMPROVEMENT

(S)WP.158/3: Mutasieteelt met pruime. 1965. M.J. van Tonder

(S)WP.158/4: Teel van pruimcultivars bestand teen bakteriese vlek. 1972. M.J. van Tonder

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(S)WP.251/9: Aanplanting en instandhouding van pruimcultivars. 1970. J.W. Etsebeth

(S)WP.251/3: Tweede fase-evaluasie van pruimcultivars in Wes-Kaap. 1971. C.W.J. Bester

(S)WP.251/5: Evaluasie van ingevoerde pruimonderstamme te Bien Donné. 1971. J.D. Stadler

(S)WP.162/3: Tweede fase-evaluasie van plaaslik geteelde pruimonderstamme. 1961. M.J. van Tonder

(S)WP.252/2: Vergelyking van opleistelsels vir pruime te Bien Donné. 1974. O. Bergh

(S)WP.229/11: Invloed van grondbewerkingspraktyke op boomprestasie by pruime. 1974. G.K. Schliemann

TEGNOLOGIE/TECHNOLOGY

VV.2444/52/1/1: Controlled atmosphere storage of plums. 1981. G.J. Eksteen

VV.2444/52/1/2: Post-harvest handling and treatments of plums to improve storage life and quality. 1982. G.J. Eksteen

SIEKTES/DISEASES

(S)WP.257/5: Besmetting en vrystelling van *Xanthomonas pruni* in pruimboorde. 1979. H.J. du Plessis

FISIOLOGIE/PHYSIOLOGY

(S)WP.240/1: Bepaling van rypheidsindekse vir pruime. 1971. H. Tormann

(S)WP.251/1: Bepaling van natbestandheid van pruimonderstamme. 1971. J.D. Stadler

APPELKOSE/APRICOTS

VEREDELING/IMPROVEMENT

(S)WP.228/1: Teling van vroeë appelkose vir inmaak. 1977. R.E. Pieterse, P.J.L. Ellis

(S)WP.228/2: Teling van appelkose geskik vir droging. 1977. P.J.L. Ellis

(S)WP.228/3: Mutasieteelt met appelkose. 1977. P.J.L. Ellis

(A)T-Rp.163/3/1: Teling en seleksie van appelkose in die somerreëngebied. 1977. T. Haulik

GEWASKUNDE/CROP SCIENCE

(S)WP.251/8: Aanplanting en instandhouding van appelkooscultivars. 1970. W.C. Nel

(S)WP.251/2: Tweede fase-evaluasie van appelkooscultivars in Wes-Kaap. 1971. C.W.J. Bester, J.D. Stadler

(S)WP.251/10: Evaluasie van appelkoosonderstamme te Robertsonproefplaas. 1971. J.D. Stadler

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TEGNOLOGIE/TECHNOLOGY

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(S)N.128/2: Nuwe plae van subtropiese gewasse. Plae van koffie, tee, speserye en medisinale plante. 1972. E.A. de Villiers

TEE/TEA

VEREDELING/IMPROVEMENT

(S)N.122/1: Teling en seleksie van tee. 1971. J.C. Snyman

VOEDING/NUTRITION

(S)N.138/1: Voedingsbehoefte van tee. 1975. B.L. Smith

PYNAPPELS/PINEAPPLES

GEWASKUNDE/CROP SCIENCE

(S)N-OL.1/3: Onkruidbeheer by pynappels. 1971. E.R. Dalldorf

(S)N-OL.1/4: Evaluasie van forseermiddels op oes en rypwording van pynappels. 1971. E.R. Dalldorf

(S)N.134/1: Fenologiese studies van die pynappelplant. 1974. D. Millar-Watt

(S)N.143/1: Studies in verband met deklae by pynappels. 1978. E.R. Dalldorf

(S)N.144/1: Bepaling van optimale plantafstande vir pynappels. 1978. E.R. Dalldorf

VEREDELING/IMPROVEMENT

(S)N-OL.5/1: Teling en seleksie van pynappels vir inmaak en varsbemarking. 1967. E.R. Dalldorf

OESHANTERING/HANDLING OF THE CROP

(S)N.145/1: Beheer van na-oessiektes en probleme van pynappelvrugte. 1979. M. Fitchet

VOEDING/NUTRITION

(S)N-OL.12/3: Bepaling van die voedingstatus van pynappels. 1972. W. Langenegger

(S)N-OL.12/4: Voedingsbehoefte van die pynappel. 1972. S.F. du Plessis

(S)N-OL.12/5: Nitraatprobleem van inmaakpynappels. 1978. B.L. Smith

PLAE/PESTS

(S)N.133/2: Studies en beheer van blaar- en vrugplae by pynappels. 1974. G.J. Petty

(S)N.133/3: Studies en beheer van grondinsekte by pynappels. 1974. G.J. Petty

(S)N.81/9: Biologie en bestryding van pynappelaalwurms. 1971. P.F. du Toit

AVOKADO'S/AVOCADOS

GEWASKUNDE/CROP SCIENCE

(S)N.117/2: Vegetatiewe voortplanting van avokado's. 1971. J.N. Moll

FISIOLOGIE/PHYSIOLOGY

(S)N.117/4: Verband tussen abnormaliteite by entverbindings en agteruitgang van avokadobome. 1972. J.P. Bouwer

VOEDING/NUTRITION

(S)N.109/1: Voedingsbehoefte van die avokado. 1970. T.J. Koen

SIEKTES/DISEASES

(S)N.86/6: Chemiese beheer van wortelverrotting by avokado's. 1971. J.N. Moll

(S)N.86/7: Weerstand van avokadocultivars en seleksies teen wortelverrotting. 1972. J.N. Moll

PLAE/PESTS

(S)N.130/1: Biologie en bestryding van insekte en myte op avokado's. 1974. A. Schwartz

OESHANTERING/HANDLING OF THE CROP

(S)N.38/1: Koelopberging en na-oesbederf by avokado's. 1963. D.H. Swarts

PIESANGS/BANANAS

VEREDELING/IMPROVEMENT

(S)N.102/1: Seleksie van varsmarkpiesangcultivars. 1968. A.J. Joubert

SIEKTES/DISEASES

(S)N.139/1: Panama wilt disease in bananas. 1976. B.Q. Manicom

VOEDING/NUTRITION

(S)N.111/3: Voedingsbehoefte van die piesang: blaarnorme. 1970. W. Langenegger

LIETSJIES

WATERBEHOEFTES/WATER REQUIREMENTS

(S)N.155: Ondersoek na besproeiingskedules en -stelsels vir piesangs. 1981. J.C. Robinson

GEWASKUNDE/CROP SCIENCE

(S)N.151: Bepaling van optimale plantpopulasie en spasiëring vir piesangs. 1980. J.C. Robinson

(S)N.152: Planttyd, suierseleksie, spasiëring en lokaliteit in verhouding tot oestye en oesvoorspellings vir piesangs. 1980. J.C. Robinson

PLAE/PESTS

(S)N.81/11: Biologie en bestryding van aalwurms op piesangs. 1975. J.M.D. Richardson

OESHANTERING/HANDLING OF THE CROP

(S)N.135/1: Na-oesprobleme van piesangs. 1975. D.H. Swarts

FISIOLOGIE/PHYSIOLOGY

(S)N.146: Aanwending van meristeemsegmente vir voortplanting van piesangs. 1980. J.P. Bouwer

MANGO'S/MANGOES

VEREDELING/IMPROVEMENT

(S)N.110/2: Teling en seleksie van vesellose mango's. (gesuspendeer)

FISIOLOGIE/PHYSIOLOGY

(S)N.110/3: Fisiologiese studies van abnormaliteite by ontwikkeling van mangovrugte. 1972. L.J. van Lelyveld

SIEKTES/DISEASES

(S)N.118/1: Beheer van bakteriese siektes op mangobome en -vrugte. 1971. B.Q. Manicom

(S)N.118/3: Beheer van mangoblommisvorming. 1971. B.Q. Manicom

VOEDING/NUTRITION

(S)N.126/1: Voedingsbehoefte van die mango. 1972. S.F. du Plessis

PLAE/PESTS

(S)N.128/1: Biologie en bestryding van mango-insekte, myte en aalwurms. 1972. E.A. de Villiers

OESHANTERING/HANDLING OF THE CROP

(S)N.118/2: Na-oeshantering van mangovrugte. 1971. B.Q. Manicom

LIETSJIES/LITCHIS

VOEDING/NUTRITION

(S)N.100/1: Voedingsbehoefte van die lietsjie. 1969. T.J. Koen

GRANADILLAS

SIEKTES/DISEASES

(S)N.136/1: Verhoutingsiekte van granadillas. (gesuspendeer)

VOEDING/NUTRITION

(S)N.129/1: Voedingsbehoefte van die granadilla. 1974. T.J. Koen

KOEJAWELS/GUAVAS

GEWASKUNDE/CROP SCIENCE

(S)N.113/2: Vergelyking tussen tye van snoei vir koejawels. 1974. A.J. Joubert

(S)N.113/3: Vergelyking tussen snoeistelsels vir koejawels. 1974. A.J. Joubert

VEREDELING/IMPROVEMENT

(S)N.113/1: Teling en seleksie van koejawels vir verwerking en varsbemarking. 1970. L.C. Bolt

PAPAJAS/PAW-PAWS

OESHANTERING/HANDLING OF THE CROP

(S)N.116/1: Na-oeshantering van papajavrugte. 1971. D.H. Swarts

VOEDING/NUTRITION

(S)N.147: Makro-elementvereistes van die papaja. 1980. G. Swart

Neute/Nuts

MAKADAMIANEUTE/MACADAMIA NUTS

GEWASKUNDE/CROP SCIENCE

(S)N.96/4: Evaluering van makadamiacultivars en -seleksies in verskillende gebiede. 1969. A.J. Joubert

(S)N.96/6: Bepaling van plantafstande vir makadamiacultivars. 1971

VOEDING/NUTRITION

(S)N.97/1: Voedingsbehoefte van die makadamia. 1968. T.J. Koen

PEKANNEUTE/PECAN NUTS

GEWASKUNDE/CROP SCIENCE

(S)N.124/1: Evaluering van pekancultivars en -seleksies. 1971. A.J. Joubert, T. Haulik

VOEDING/NUTRITION

(S)N.106/1: Voedingsbehoeftes van die pekanneut. 1969. T.J. Koen

ROOIBOSTEE

SIEKTES/DISEASES

(S)N.150: Beheer van *Fusicladium effusum* op pekanneute.

AMANDELS/ALMONDS

GEWASKUNDE/CROP SCIENCE

(S)WP.242/1: Tweede fase-evaluasie van amandelcultivars in die Westelike Provinsie. 1971. E.J. van Zyl

Radioïsotope/Radio Isotopes

RADIOïSOTOPIE/RADIO ISOTOPY

CHEMIES-FISIESE STUDIES/CHEMICAL-PHYSICAL STUDIES

(S)WP.245/1: Bepaling van grondvog en -digtheid met gamma-attenuasie. 1975. J.H.M. Karsten

(S)WP.245/4: Scandium-46 en Gallium-67 as merkers vir aluminium in grond- en plantstudies. 1978. W.A.G. Kotzé, J.F. de Villiers

(S)WP.245/5: Bepaling van grondvog- en digtheid naby die grondoppervlak met behulp van neutrone en gammastrale. 1979. J.H.M. Karsten

(S)WP.235/1: Bestraling van vrugtevlieë. 1972. B.N. Barnes

Diverse Tuinbougewasse/Sundry Horticultural Crops

KIWIVRUGTE/KIWI FRUIT

GEWASKUNDE/CROP SCIENCE

(S)WP.243/2: Tweede fase-evaluasie van kiwivrugcultivars in die Westelike Provinsie. 1977. D.C. Uys

ANDER TUINBOUGEWASSE/OTHER HORTICULTURAL CROPS

GEWASKUNDE/CROP SCIENCE

(S)N.137/1: Aanpasbaarheidstudies van diverse subtropiese gewasse. 1975. A.J. Joubert

PLAE/PESTS

(S)N.128/1: Plae van diverse subtropiese vrugte. 1972. E.A. de Villiers

VYE/FIGS

GEWASKUNDE/CROP SCIENCE

(S)WP.243/1: Tweede fase-evaluasie van vyecultivars in die Westelike Provinsie. 1974. E.J. van Zyl

ROOIBOSTEE/RED TEA

FISIOLOGIE/PHYSIOLOGY

(S)WP.243/4: Groeisiklus en koolhidraat- en stikstofreserwes by rooitee. 1979. P.J.C. Stassen

PLANTBESKERMINGSNAVORSING/PLANT PROTECTION RESEARCH

Insektekunde: Dierkunde/Entomology: Zoology

INSEKTE/INSECTS

TAKSONOMIE/TAXONOMY

(A)I-Pr.123: Nasionale versameling van insekte in suidelike Afrika. 1972. G.L. Prinsloo, M.W. Mansell, C.D. Eardly, S.J. van Tonder

(A)I-Pr.10: Taksonomie en verspreiding van Isoptera in suidelike Afrika. 1955. J.L. Sheasby, W.G.H. Coaton

(A)I-Pr.2: Taksonomie en verspreiding van Tephritidae in suidelike Afrika. 1921. H.K. Munro

(A)I-Pr.108: Taksonomie en verspreiding van Afrika se wespes in die families Encyrtidae en Aphelinidae. 1970. G.L. Prinsloo, D.P. Annecke

(A)I-Pr.126: Taksonomiese studies op suidelike Afrika se Saturniidae. 1976. H. Geertsema

(A)I-Pr.147: Biologie en sistematiek van Myrmeleontidae en Nemopteridae in suidelike Afrika. 1977. M.W. Mansell

(A)I-Pr.150: Sistematiek van die Hymenoptera Aculeata van suidelike Afrika met spesiale verwysing na die Xylocopinae. 1978. C.D. Eardly

BESTUIWING/POLLINATION

(A)I-Pr.113: Rol van insekte by saadproduksie van sekere gewasse in die Oudtshoorngebied. 1972. R.H. Anderson

(A)I-Pr.112/1: Bio-ekologie van houtboorderbye met spesiale verwysing na hulle belangrikheid as bestuiwers van landbougewasse in Suid-Afrika. 1978. R.H. Watmough

(A)I-Pr.112/2: Bestuiwing van lusern met behulp van solitêre bye om saadproduksie te verbeter. 1972. R.H. Anderson

GEïNTEGREERDE BEHEER/INTEGRATED CONTROL

(A)I-Pr.145/1: Laboratoriumevaluasie van kandidaatplaagdoders teenoor *H. armigera*. 1978. M.C.J. Basson, S. van der Walt

(A)I-Pr.145/2: Beheer en invloed van plaagdoders toegedien onder veldtoestande teenoor *H. armigera*, natuurlike vyande en rooispinmytbevolkings. 1978. N.C.J. Basson, S. van der Walt

(A)I-Pr.145/3: Ondersoek na plaagdoderweerstandbiedendheid van *H. armigera* in Suid-Afrika. 1978. N.C.J. Basson, S. van der Walt

(A)I-Pr.145/4: Manipulasie van olfaktoriese kommunikasie in *H. armigera*-bevolkingsdigthede in die veld. 1979. C.A. Bruzas, N.C.J. Basson

(A)I-Pr.148/1: Fundamentele studies rakende die gebruik van natuurlike vyande vir die beheer van *H. armigera*. 1978. H. van Hamburg, R.S. du Plessis

(A)I-Pr.135: Studie om aanvullende natuurlike vyande in te voer en te bepaal watter wingerdpraktyke natuurlike vyandaktiwiteite bevorder. 1978. A.J. Urban

BIOLOGIESE BEHEER/BIOLOGICAL CONTROL

(A)I-Pr.129/1: Bio-ekologiese studie van *L. frustralis*. 1975. J.D. Möhr, M.W. Pretorius

(A)I-Pr.148/2: Gebruik van biologiese metodes vir die beheer van stamruspes in graangewasse. 1978. H. van Hamburg

AALWURMS/EELWORMS

TAKSONOMIE/TAXONOMY

(A)I-Pr.80/3: Opname van die Suid-Afrikaanse aalwurmfauna en opbou van 'n permanente nasionale versameling. 1962. E. van den Berg, K.P.N. Kleynhans, A. Pais-Madeira

(A)I-Pr.80/11: Opname van die plantparasitiese aalwurmspesies wat plante in Suid-Afrika aanval. 1979. D.P. Keetch

PLAE/PESTS

(A)I-Pr.80/10: Chemiese beheer van aalwurms wat mielies in Suid-Afrika aanval. 1978. I.W. Louw, A. du Toit, H. van Ark

(A)I-Pr.96/3: Reaksie van gevestigde wingerde op behandeling van aalwurmdoders. 1972. P.C. Smith

(A)I-Pr.96/4: Bestudering van die oordraging van wingerdvirussiektes deur aalwurms. 1975. P.C. Smith

(A)I-Pr.96/5: Voorkoms en verspreiding van aalwurms in besproeiingswater. 1980. P.C. Smith, A.P. van Mieghem

PB.2512/20/1: Influence of nursery practices on the nematode population in vineyards in the Western Cape. 1982. W. Pieterse

MYTE/MITES

TAKSONOMIE/TAXONOMY

(A)I-Pr.44: Sistematiek van myte van landboukundige belang. 1959. M.K.P. Meyer, M.C. Boulton

(A)I-Pr.77/1: Opname, taksonomie en bio-ekologie van roofmyte in Suid-Afrika. 1962. S.C. Cruikshank, E.A. Ackerman

PLAE/PESTS

(A)I-Pr.103/1: Laboratoriumevaluering van kandidaat- chemiese beheermiddels teenoor *Tetranychus cinnabarinus, T. ludeni* en *T. lombardinii*. 1977. D. Lombaard, J.H. Botha, N.C.J. Basson

(A)I-Pr.103/2: Evaluering van belowende chemiese beheermiddels onder veldtoestande teen *Tetranychus cinnabarinus, T. ludeni* en *T. lombardinii*. 1977. J.H. Botha, D. Lombaard, N.C.J. Basson

(A)I-Pr.103/3: Voortdurende bepaling van weerstandbiedendheid van *Tetranychus cinnabarinus, T. ludeni* en *T. lombardinii* teen chemiese beheermiddels. 1977. D. Lombaard, N.C.J. Basson

SPINNEKOPPE/SPIDERS

TAKSONOMIE/TAXONOMY

(A)I-Pr.138: Sistematiek van spinnekoppe wat predatore van skadelike myte en insekte is. 1976. A.S. Dippenaar

KNAAGDIERE/RODENTS

PLAE/PESTS

(A)I-Pr.101: Studie van die bestryding van *Tatera brantsii* en *Praomys (Mastomys) natalensis.* 1969. S. Stiemie

HEUNINGBY/HONEYBEE

SIEKTES/DISEASES

(A)I-Pr.124/3: Siektes van die volwasse heuningby. 1975. B. Buys

VEREDELING/UPGRADING

(A)I-Pr.121: Seleksie van verbeterde teellyne van heuningbye. 1972. R.H. Anderson

(A)I-Pr.124/4: Gebruik van bestandheid teen siektes en plae in die seleksie van verbeterde lyne van die heuningby. 1975. B. Buys

VOEDING/NUTRITION

(A)I-Pr.122: Stimulerende voeding van heuningbye. 1972. R.H. Anderson, M.F. Johannsmeier, J.L. de Wit

(A)I-Pr.99: Nektar- en pollenflora van Suid-Afrika. 1975. M.F. Johannsmeier

GEDRAGSTUDIES/BEHAVIOUR STUDIES

(A)I-Pr.119: Gedrag van heuningbye in boorde tydens bestuiwing. 1972. R.H. Anderson

PLAAGDODERS/PESTICIDES

CHEMIES/CHEMICAL

(A)I-Pr.153/1: Ontwikkeling en verbetering van analitiese metodes van piretroïdes op verskillende matrikse.

(A)I-Pr.153/2: Ontwikkeling en verbetering van tegnieke om chromatografiese resolusie te verbeter ten opsigte van moeilik skeibare plaagdoders.

(A)I-Pr.151/1: Bepaling van nematodedoders in wyndruiwe.

(A)I-Pr.97/9: Residue in rou groente en diereprodukte.

(A)I-Pr.152/1: Wisselwerking tussen dimetoaat en bromasil in sitrusboorde.

TEGNOLOGIE/TECHNOLOGY

(A)I-Pr.154/1: Invloed van bymiddels op die verdampingstempo van spuitmengsels wat op katoen gebruik word.

(A)I-Pr.154/2: Invloed van reën op die nablywing van plaagdoders op katoen.

OPGEBERGDE GRAAN/STORED GRAIN

PLAE/PESTS

(A)I-Pr.24/1: Gebruik van kontakmiddels vir die beheer van insekte in opgebergde graan en graanprodukte. 1955. J.H. Viljoen

SWAMME

(A)I-Pr.24/2: Gebruik van giftige en inerte gasse vir bestryding van opbergingsplae. 1955. J.H. Viljoen

(A)I-Pr.134/1: Insekmiddelbestandheid by *Tribolium*-spesies. 1976. J.H. Viljoen, H. van Ark

BOSBOME EN TIMMERHOUT/FOREST TREES AND TIMBER

PLAE/PESTS

(A)I-Pr.9/9: Ondersoek van die bio-ekologie, swamassosiasies en beheer van baskewers op dennebome in suidelike Afrika. 1979. H. Geertsema, M. Wingfield, G. Tribe

(A)I-Pr.72/3: Beheer van hout- en timmerinsekte. 1955. H. Geertsema, T.J. Cillie

(A)I-Pr.143: Ondersoek na die bio-ekologie en plaagstatus van die swart denneplantluis, *Cinara cronartii*, in denneplantasies en die biologiese beheer van die plantluis deur invoer van natuurlike vyande. 1977. N.J. van Rensburg

Plantsiektekunde: Mikrobiologie/Plant Pathology: Microbiology

SWAMME/FUNGI

TAKSONOMIE/TAXONOMY

(A)PS-Pr.17/1: Identifikasie van diverse swamme. 1973. G.C.A. van der Westhuizen, D.B. Scott, A.P. Baxter, C. Roux, A.H. Thompson

(A)PS-Pr.17/2: Eetbare, oneetbare en giftige sampioene en paddastoele. 1973. G.C.A. van der Westhuizen

(A)PS-Pr.17/5: *Phialophora*-agtige swamme op die wortels van Graminae. 1980. D.B. Scott

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MIKOLOGIE/MICOLOGY

(A)PS-Pr.35/2: Geeldikkop van skape. 1975. G.C.A. van der Westhuizen

(A)PS-Pr.35/3: "Facial eczema" van skape. 1971. G.C.A. van der Westhuizen

(A)PS-Pr.35/4: Ondersoek van diverse voermonsters vir moontlike toksigene swamme. 1978. Cecilia Roux

SIEKTES/DISEASES

(A)PS-Pr.41/2: Voorkoms van patogene swamme op diverse plaaslik geproduseerde en ingevoerde saadmonsters. 1975. M.A. Holtzhausen, G.C.A. van der Westhuizen, A.P. Baxter

(A)PS-Pr.57/1: Verspreiding en gasheerreeks van *P. cinnamomi*. 1977. S. von Broembsen

(A)PS-Pr.57/2: Oorlewing en verspreiding in grond. 1977. S. von Broembsen

(A)PS-Pr.57/3: *Phytophthora*-wortel- en kraagvrot van verboude proteas. 1977. S. von Broembsen

(A)PS-Pr.57/4: Voorkoms en verspreiding in riviere en ander natuurlike water. 1977. S. von Broembsen

PB.2521/19/3/1: Epidemiology and control of diseases caused by the fungus *Sclerotinia sclerotiorum*. 1982. G.W. Herd

BAKTERIEË/BACTERIA

STIKSTOFBINDING/NITROGEN FIXATION

(A)PS-Pr.21/2: Uittoets van kommersiële peulplantentstowwe. 1976. H.J. van Rensburg, B.W. Strijdom

(A)PS-Pr.21/17: Seleksie van *Rhozobium*-rasse vir entstofvervaardiging. 1968. B.W. Strijdom, C.J. Otto

(A)PS-Pr.21/18: Ondersoek na die rol wat lektiens speel by spesifisiteit van *Rhizobium*. 1978. I.J. Law, B.W. Strijdom

(A)PS-Pr.21/20: Relatiewe belangrikheid van stikstofbindingsvermoë by *Rhizobium*-seleksie. 1975. H.J. van Rensburg, B.W. Strijdom

(A)PS-Pr.44/1: Evaluering van stikstofbinding by gras wat vir weidingsdoeleindes aanbeveel word. 1975. J.L. Staphorst

(A)PS-Pr.44/2: Evaluering van stikstofbinding by veldgrasse in natuurlike ekosisteme. 1975. J.L. Staphorst

SIEKTES/DISEASES

(A)PS-Pr.37/5: Roetine-identifikasie en moontlike beheer van bakteriese patogene verkry van verskillende Streke en Institute. 1979. C.C. Deschodt

(A)PS-Pr.37/2: Omvang en aard van saadgedraagde bakteriese siektes by plaaslik geproduseerde bonesaad. 1974. C.C. Deschodt

(A)PS-Pr.43/4: Kroongal (*Agrobacterium tumefaciens*) in wingerd, kern- en steenvrugte: chemiese en fisiese beheer. 1978. F.G.H. van Zyl

(A)PS-Pr.43/5: Kroongal (*Agrobacterium tumefaciens*) van wingerd, kern- en steenvrugte: biologiese beheer. 1978. F.G.H. van Zyl, J.A. Thompson

(A)PS-Pr.43/6: Kroongal (*Agrobacterium tumefaciens*) van wingerd, kern- en steenvrugte: voorkoms op verskillende gashere. 1978. F.G.H. van Zyl

VIRUSSE/VIRUSES

SIEKTES/DISEASES

(A)PS-Pr.38/1: Opsporing en uitkenning van virusse in druiwe. 1970. D.J. Engelbrecht

(A)PS-Pr.38/2: Uitskakeling van virusse in druiwe. 1970. D.J. Engelbrecht, F.A. de Milander

(A)PS-Pr.39/1: Opsporing en uitkenning van virusse in kern- en steenvrugte. 1970. J. Thatcher, V.Z. Siebert

(A)PS-Pr.62/1: Roetinebepaling en identifikasie van virusse op plante behalwe peul- en grassoorte. 1980. V.H. Whitlock

(A)PS-Pr.62/2: Studie van die virussiektes van cassava, *Manihot esculenta*. 1980. V.H. Whitlock

(A)PS-Pr.63/1: Roetinebepaling en identifikasie van virusse op peul- en grassoorte. 1980. G. Pietersen

(A)PS-Pr.63/2: Studie van die virussiektes van mielies in Suid-Afrika. 1980. G. Pietersen

(A)PS-Pr.63/3: Studie van die virussiektes van plaaslike en ingevoerde bone, *Phaseolus*-, *Cyamopsis*- en *Vicia*-spesies. 1980. V.H. Whitlock

PLANTSIEKTES/PLANT DISEASES

DATABERGING/DATA STORAGE

(A)PS-Pr.61: Databank oor plantsiektes op plante wat by die Stellenbosch-kwarantynstasie hanteer word. 1981. P.M. von Maltitz

BOSBOME EN TIMMERHOUT/FOREST TREES AND TIMBER

SIEKTES/DISEASES

(A)PS-Pr.45/2: Opname van plantsiektes in bosbouplantasies. 1975. M.J. Wingfield

(A)PS-Pr.45/3: Opname van siektes in bosboukwekerye. 1975. M.J. Wingfield

WEIDINGSGEWASSE/PASTURE CROPS

SIEKTES/DISEASES

(A)PS-Pr.58/1: Opname van siektes van lusern. 1978. A.H. Thompson, G.C.A. van der Westhuizen

(A)PS-Pr.58/3: Opnames van die voorkoms van siektes by aangeplante peulgewasgrasweidings in somerreëngebiede. 1979. L.J. Mills

(A)PS-Pr.58/4: Besmetting en siekteontwikkeling by *Leptosphaerulina*-blaarvlek van lusern. 1980. S.C. Bekker

Elektrondienste/ Electron Services

ELEKTRONMIKROSKOPIE/ELECTRON MICROSCOPY

ANATOMIE/ANATOMY

(A)PS-Pr.60: Voorbereiding en ondersoek van biologiese monsters. 1979. H.J. van Tonder

Onkruidnavorsing/Weed Research

ONKRUIDE/WEEDS

BIOLOGIESE BEHEER/BIOLOGICAL CONTROL

(A)I-Pr.61/2: Biologiese beheer van litjieskaktus, *Opuntia aurantiaca*. 1960. H.G. Zimmermann, J.H. Hoffmann

(A)I-Pr.61/3: Evaluasie van *Dactylopius austrinus* as natuurlike insekvyand van litjieskaktus. 1975. H.G. Zimmermann

(A)I-Pr.61/4: Massateling en populasiedinamika van *Tucumania tapiacola*, 'n insek vir die beheer van litjieskaktus. 1976. J.H. Hoffmann

(A)I-Pr.61/1: Biologiese beheer van turksvy, *Opuntia ficus-indica*. 1960. H.G. Zimmermann, W.A. Burger

(A)I-Pr.63: Biologiese beheer van *Lantana camara*. 1969. C.J. Cilliers

(A)I-Pr.131/1: Biologiese beheer van *Hakea sericea, H. gibbosa* en *H. suaveolens*. 1972. S. Neser, R. Kluge

(A)I-Pr.131/2: Biologiese beheer van *Hypericum perforatum*. 1972. S. Neser, R. Kluge

(A)PS-Pr.59: Studie van die siektes van sommige inheemse en uitheemse onkruide wat deur plaaslike patogene veroorsaak word. 1979. M.J. Morris

CHEMIESE BEHEER/CHEMICAL CONTROL

K-Gf.143/1: Chemiese beheer van *Prosopis* spp. in die Noordwes-Karoo. 1980. P. Botha

EKOLOGIE/ECOLOGY

PB.2551/27/1/1: Ecology of the weed *Acacia longifolia*. 1983. P.J. Pieterse

PB.2551/27/1/2: Ecology of the weed nassella tussock (*Stipa trichotoma*). 1983. D.C. Joubert

DIEREPRODUKSIEBEVORDERING/ANIMAL PRODUCTION PROMOTION

DIEREPRODUKSIE- EN DIEREPRODUKTENAVORSING/ANIMAL PRODUCTION AND ANIMAL PRODUCTS RESEARCH

Diersoort/Animal Type

VLEISBEESTE/BEEF CATTLE

VEREDELING/UPGRADING

(A)VS-Pr.112/4: Evaluering van Bonsmarabulle uit departementele teellyne by sentrale groeitoetssentrums.

O-Vh.70/4: Kruisteling met die Afrikanerkoei as basis met verskillende grootraamvleisrasse onder 'n semi-intensiewe stelsel van produksie. 1973. D.L. Els

O-Vh.70/5: Aanwending van verskillende vleisbeesrasse as manlike en vroulike teelmateriaal in suiwer en kruisteeltstelsels. 1976. D.L. Els

O-Vh.70/7: Produksiepotensiaal van vroulike kruisings uit Afrikanerkoeie met verskillende grootraamrasse. 1976. D.L. Els

(A)VS-Pr.112/3: Ontwikkeling en veredeling van die Edelheer- en Roodebosteellyne te Dohne, Oos-Kaapstreek. 1980. A.J. Fourie

GENETIKA/GENETICS

(A)VS-Pr.34/1: Oorerwing van laminitis by Afrikanerbeeste. 1971. E.H.H. Lourens

FISIOLOGIE/PHYSIOLOGY

(A)VS-Pr.76/7: Fisiologiese tegnieke vir die prestasietoetsing van vleisbeesbulle. 1973. J.J. Harmse

OK-Do.70/3: Lae kalfpersentasie en hormoonstatus van vleisbeeste op Dohne-suurveld. 1979. J.A. Erasmus

BESTUUR/MANAGEMENT

N-Ce.115/7: Production potential and cost of farm produced roughages. 1971. R.M. Bredon

N-Ko.5/5: Evaluation of veld potential with beef animals. 1975. A.D. Lyle

N-Dd.5/2: Fertilisation and reinforcement of old lands under grazing. 1974. H.J. Meaker

N-Th.12/1: Effect of different breeding and feeding areas on performance of cattle. 1963. S.F. Lesch

N-Ce.115/14: Performance of dual and British beef cattle on established pasture. 1976. B.P. Louw

N-Ce.115/15: Stocking rates and lick supplementation on animal performance on Highland sourveld. 1975. P.P. Whitwell

N-Ko.5/3: Season of mating and reproduction and performance of beef females. 1971. A.D. Lyle

N-Ce.115/23: Winter growth levels and stocking rates on Highland sourveld for replacement heifers. 1981. A. van Niekerk

N-Ce.115/24: Evaluation of *E. curvula* silage ensiled at the hay cutting stage for wintering replacement heifers. 1981. A. van Niekerk

N.5341/41/1/4: The influence of stocking rate on the reproduction performance of beef cows and on the veld in the high rainfall sourveld, 4f of Natal. 1982. A.D. Lyle

REPRODUKSIE/REPRODUCTION

N-Ce.115/17: Pre-partum feeding levels and target mass at mating on reproduction of cows. 1978. H.J. Meaker

N-Ce.115/18: Oestrus and ovulation in mature beef cows as effected by changes in live mass. 1978. H.J. Meaker

N-Ce.115/20: Influence of restricted suckling on the reproductive performance of beef cows. 1980. B.P. Louw

O-Vh.71/4: Ondersoek na praktyke van die inkorting van die kalfinterval by Afrikanerkoeie. 1979. J.A. Vermeulen

O-Vh.71/5: Stabilisering van LH-vrystelling tydens gesinchroniseerde estrusperiodes by die bees. 1979. J.A. Vermeulen

O-Vh.71/6: Ondersoek na die gebruik van gonadotrofiese vrystellingshormoon by die toepassing van K.I. onder ekstensiewe toestande. 1979. J.A. Vermeulen

VOEDING/NUTRITION

H-Ps.197/2: Invloed van byvoeding op die vrugbaarheid van jong vleisraskoeie. 1963. R.J. Theunissen

H-Ps.214/6: Vergelyking tussen mielie- en sorghumgraan as bronne van kragvoer in afrondingsrantsoene vir vleisbeeste. 1980. H.J. van der Merwe

H-Ps.253/1: Kalfproduksie uit die vleisbeeskudde deur middel van optimale somerbenutting van bemeste veld. 1976. J.W. Cilliers

H-Bl.68/4: Beesvleisproduksie op wintergraanweidings op 'n vlak Avalongrond in die Oos-Vrystaat. 1979. K.G. Cronje

OK-Do.53/10: Benutting van Monensin-natrium in winter- en somerlekke in die suurgrasveld van die Oos-Kaapstreek. 1979. W.P. Henning

MELKBEESTE/DAIRY CATTLE

VEREDELING/UPGRADING

(A)VS-Pr.18/1: Genetiese variasie in melk- en bottervetproduksie. 1965. G.P. Kühn

(A)VS-Pr.18/2: Nie-genetiese variasie in melk- en bottervetproduksie. 1965. G.P. Kühn

(A)VS-Pr.21/1: Maatstaf vir die bepaling van "elite"-koeie. 1964.

(A)VS-Pr.80: Seleksie vir melkbaarheids- en melkkwaliteitseienskappe by melkbeeste. 1971. J.H. Hofmeyr, M.H. Neitz, C.Z. Roux

GENETIKA/GENETICS

(A)VS-Pr.24/1: Oorerwing van laminitis by Jerseybeeste. 1965. E.H.H. Meyer, D.J. Lourens

VOEDING/NUTRITION

(A)VS-Pr.26/10: Ureum as 'n stikstofbyvoeding in melkkoeirantsoene. 1979. M.H. Neitz

VLEISSKAPE

N-Ce.123/3: Chemical composition and nutritive value of kikuyu pastures for dairy cattle. 1972. R.M. Bredon

N-Ce.123/4: Chemical composition and nutritive value of tall fescue pasture for lactating cows in Bioclimate group III. 1980. R.M. Bredon

N-Ce.123/5: Utilisation of urea using silage for dairy cows. 1977. R.M. Bredon

H-Ps.242/5: Benutting van skaapmis as 'n remfaktor in kragvoermengsels vir melkkoeie. 1979. W.C. Hugo

H-Ps.263/1: Optimisering van weipoeier, sojameel en kolostrummengsels vir die grootmaak van melkbeeskalwers. 1978. W.C. Cruywagen

H-Ps.242/6: Benutting van *Digitaria smutsii* as weidingsgewas deur lakterende melkkoeie. 1979. W.C. Hugo

H-Bl.68/3: Melkproduksie op wintergraanweidings in die Oos-Vrystaat op 'n vlak Avalongrond. 1979. K.G. Cronje

VS.3112/05/1/3: Urea in complete diets for dairy cattle. 1982. L.J. Erasmus

BESTUUR/MANAGEMENT

(A)VS-Pr.99/3: Biologies-ekonomiese data-ontledingsdiens vir melkprodusente. 1980. M.H. Neitz

N-Ce.123/7: Effect of shade upon milk production of lactating cows grazing summer pasture. 1981. T.J. Dugmore

N-Ce.123/8: Cedara dairy herd data bank. 1981. T.J. Dugmore

W-Eb.104/4: Evaluasie van melkbeesbehuisingstelsels in die Winterreënstreek. 1981. C.J.C. Muller

VLEISSKAPE/MUTTON SHEEP

FISIOLOGIE/PHYSIOLOGY

(A)VS-Pr.73/10: Invloed van voerbeperking op die liggaamsamestelling van vleisskape. 1978. H.H. Meissner

VEREDELING/UPGRADING

K-Gf.128/1: Seleksie vir vleisproduksie en vrugbaarheid by Dorperskape. 1978. P.G. Marais

K-Gf.128/2: Liggaamsamestelling van Dorperskape. 1976. P.G. Marais

K-Kn.5: Ontwikkeling van 'n witwolvleisras vir ekstensiewe skaapweistreke. 1969. J.J. Olivier

O-Kf.19/1: Seleksiestudies met Dorperskape. 1966. D.L. Els

VS.3133/07/1/3: The evaluation of highly fertile sheep breeds and strains in crosses. 1982. J.C. Greeff

BESTUUR/MANAGEMENT

N-Ce.136/1: Three intensive slaughter lamb production systems for higher rainfall areas in Natal. 1975. J. Grobbelaar

W-Eb.102/5: Ondersoek na die plasmaluteïeniserende hormoonkonsentrasie (LH) voor puberteit as 'n vroeë seleksiemaatstaf van vrugbaarheid en fekunditeit by skape. 1977. N.M. Kritzinger

W-Lg.12/5: Studie van oorsake tot hoë lamvrektes in die Winterreënstreek. 1978. T.T. de Villiers

W-Sb.142/1: Slaglamproduksie in die Suid-Kaap. 1972. L.S. Erasmus

MUTTON SHEEP

W-Sb.142/2: Versnelde paringsfrekwensie met skape. 'n Vergelyking van twee bestuurstelsels vir produksie van slaglammers. 1979. L.S. Erasmus

W.5332/41/1/1: The use of plastic coats to cut down lamb mortality in the George area of the eastern seaboard of the Winter Rainfall Region. 1982. S.W.P. v.d. M. Cloete

REPRODUCTION/REPRODUKSIE

N-Ce.136/4: Subnormal luteal function in ewes after seasonal anoestrus. 1979. J. Grobbelaar

N-Ce.136/5: Effect of post-partum GnRH treatment and the role of PMSG in luteal maintenance. 1980. J. Grobbelaar

WOLSKAPE/WOOLLED SHEEP

VEREDELING/UPGRADING

T-Ng.52/4: Histologiese evaluering van vel en vesel by ouerraswolskape. 1972. J.H. Dreyer

T-Ng.52/5: Histologiese evaluering van vel en vesel van Merino F1-kruisings. 1972. J.H. Dreyer

K-Gf.105: Halfklasvaggewigstelsel as seleksiemetode by Merinoskape. 1965. J.A.A. Baard

K-Gf.72: Vergelyking van verskillende seleksiemetodes by Merinoskape. 1962. J.J. Olivier

K-Gf.75: Gelyktydige tweerigtingseleksie vir wolkwaliteit en wololie by Merino's. 1962. J.M. Cloete

OK-Bh.38: Teling en integrasie van 'n wolvleisskaap in die kusstreke van die Oos-Kaap. 1959. F.O.C.W. Karberg, H.H. Barnard

OK-Do.88/2: Teel en seleksie van die Dohne-Merino met behulp van prestasietoetsing. 1979. A.J. Fourie

OK-Do.88/3: Daarstelling, instandhouding en implementering van 'n geneties stabiele kudde vir die Dohne-Merino. 1979. A.J. Fourie

W-Eb.102/4: Vergelyking van seleksieprosedures vir verhoging van fynwolproduksie by Merinoskape. 1976. J.J. du Plessis

W.5372/07/1/2: Determination of relationships between growth rate and different production traits of woolled sheep on dryland grazings in the south coastal area to improve management 1982. S.W.P. v.d. M. Cloete

VOEDING/NUTRITION

K-Gf.129/4: Invloed van energie- en proteïenaanvulling met en sonder fosforaanvulling op produksie en reproduksie van Merinoskape op vier soorte Karooveld. 1977. F.C. Hayward, G.A. Jacobs

K-Gf.111/9: Bepaling van optimale peile van energievoeding van lakterende ooie van wolskape op *Atriplex nummularia*. 1980. G.A. Jacobs

N-Ce.112/3: Ensilaging of kikuyu for winter feeding of sheep. 1970. S.F. Lesch

N-Ko.5/6: Influence of phosphorus supplementation to a Merino lambing flock. 1976. A.D. Lyle

H-Bl.68/2: Slaglamproduksie op wintergraanweiding in die Oos-Vrystaat. 1978. A.J. van Heerden

H-Bl.68/5: Inname en voedingswaarde van triticale en raaigrasweiding vir slaglammers. 1980. A.J. van Heerden

OK-Do.64/12: Benutting van Monensin-soda in proteïenenergielekke vir lammerooie op suurveld. 1979. W.P. Henning

BESTUUR/MANAGEMENT

K-Gf.145/1: Wolskaapproduksiestelsel op besproeide lusern. 1979. A.G. Bezuidenhout

OK-Bh.44/1: Intensiewe skaapproduksiestelsel, Bathurst. 1976. F.O.C.W. Karberg, H.H. Barnard

V.5362/41/1/3: Increasing production of Merino ewes in the central grassveld area on dryland lucerne in a spring lambing season. 1982. C.J. Louw

FISIOLOGIE/PHYSIOLOGY

K-Gf.139/2: Geslagshormoonpeile gedurende die bronstigheidsiklus van die Merino-ooi in die herfs en lente. 1976. D. Wentzel

PELSSKAPE/PELTED SHEEP

VEREDELING/UPGRADING

(A)VS-Pr.109/1: Verbetering van 'n wit Karakoelkudde. 1979. J.H. Hofmeyr

O-Ut.38/1: Ontwikkeling van 'n spesifieke grysbruin en silwerpuntige sjokoladebruinpels by Karakoelskape. 1962. A.S. Faure

O-Ut.38/2: Seleksielyne by Karakoelskape. 1963. A.S. Faure

O-Ut.38/5: Effek van kruisteelt op sekere kwantitatiewe eienskappe. 1966. A.S. Faure

REPRODUKSIE/REPRODUCTION

O-Ut.32/14: Verlaging van die koste van hormoonbehandelings by skape. 1978. A.S. Faure

O-Ut.32/15: Invloed van seisoen van geboorte op puberteit, semenproduksie en LH-vlakke van Karakoelramme. 1979. A.S. Faure

O-Ut.32/16: Invloed van voeding en estrogene op die reproduksie van jong Karakoelooie. 1979. A.S. Faure

VOEDING/NUTRITION

V.5352/05/1/2: The influence of nutrition during pregnancy on the pelt quality of Karakul lambs at the Karakul Research Station. 1982. G.N. Esterhuysen

SYBOKKE/ANGORA GOATS

VEREDELING/UPGRADING

(A)VS-Pr.89/3: Bestudering van die teeltstruktuur van die Angorabok. 1977.

K-Gf.104/1: Seleksie vir vageienskappe en vrugbaarheid by Angorabokke. 1966. L. de W. Louw

FISIOLOGIE/PHYSIOLOGY

K-Gf.138/1: Endokrinologiese studies van aborsie by die Angorabok. 1973. D. Wentzel

K-Gf.138/3: Invloed van koue op aborsie by die Angorabok. 1975. D. Wentzel

ANGORA GOATS

K-Gf.139/1: Geslagshormoonpeile gedurende die bronstigheidsiklus van die Angorabokooi. 1976. D. Wentzel

K-Gf.139/3: Verwantskap tussen hormoonpeile van die Angoraboklam en daaropvolgende reproduksiepotensiaal van die volwasse ooi. 1976. D. Wentzel

K-Gf.140/1: Hormoonpeil van die Angorabokram gedurende periodes van hoë en lae geslagsaktiwiteit. 1977. D. Wentzel

K-Gf.138/2: Invloed van energievoeding op aborsie by die Angorabok. 1975. D. Wentzel

VLEISBOKKE/MEAT GOATS

FISIOLOGIE/PHYSIOLOGY

(A)VS-Pr.39/7: Bevriesing van Boerboksemen. 1974. J.P.C. Greyling

(A)VS-Pr.110/1: Ondersoek na geslagsfisiologie van die Boerbokooi. 1980. J.P.C. Greyling

VEREDELING/UPGRADING

OK-Do.90/1: Genetiese evaluasie van twee veredelde Boerbokgenotipes. 1980. A.J. Fourie

VARKE/PIGS

VOEDING/NUTRITION

(A)VS-Pr.87/6: Optimale insluitingspeile van proteïene in varkdiëte. 1979. E.H. Kemm

(A)VS-Pr.87/7: Gedehidreerde lusern in varkdiëte. 1979. E.H. Kemm

(A)VS-Pr.111/1: Kwantifisering van die proteïenneerleggingsvermoë van verskillende varkrasse. 1980. F.K. Siebrits

W-Eb.101/4: Optimale vismeelpeile en diëte van groeiende varke. 1978. N.M. Kritzinger

W-Eb.101/7: Insluiting van koringstrooi as verdunningsbestanddeel in varkafrondings-diëte. 1979. N.M. Kritzinger

FISIOLOGIE/PHYSIOLOGY

(A)VS-Pr.100/2: Faktore wat die puberteit van varksoggies beïnvloed. 1977. A.R. Gee

(A)VS-Pr.107/1: Gebruik van semen in vloeibare vorm vir kunsmatige inseminasie by varke. 1979. A.R. Gee

PLUIMVEE/POULTRY

VOEDING/NUTRITION

(A)VS-Pr.98/1: Invloed van verskillende peile vismeel op die eierproduksie van lêhenne. 1975. J. Erasmus

(A)VS-Pr.98/3: Effek van fosforpeile op aantal, grootte en gehalte van hoendereiers. 1977. J. Erasmus

(A)VS-Pr.92/2: Invloed van beperkte voeding gedurende die jong stadium op die latere prestasie van die eend. 1974. M.D. Olivier

(A)VS-Pr.91/1: Voedingsvereistes vir groei van Sjinese ganse. 1965. M.D. Olivier

VS.311*10*/05/1/4: The use of grain sorghum (*Sorghum vulgare*) in chicken diets. 1982. I.P. Swart

VEREDELING/UPGRADING

(A)VS-Pr.82/1: Teling van lêrasse met geslagsgekoppelde veerkleur. 1970. G.F. Potgieter, N.P.G. Prinsloo, E.A. Pretorius

(A)VS-Pr.82/2: Teling van lêrashoenders met rooi of goue veerkleur. 1970. G.F. Potgieter, N.P.G. Prinsloo, E.A. Pretorius

(A)VS-Pr.82/4: Teling van Australorps vir eierproduksie. 1967. G.F. Potgieter, N.P.G. Prinsloo, E.A. Pretorius

(A)VS-Pr.82/5: Instandhouding van genetiese materiaal vir hoenders 1970. G.F. Potgieter, N.P.G. Prinsloo, E.A. Pretorius

(A)VS-Pr.82/8: Die New Hamsphire-genetiese kontroletrop. 1976. J.J. Joubert, J.J. Gregorowski

(A)VS-Pr.82/3: Genetiese kombinasievermoë van hoenderrasse en -bloedlyne. 1972. G.F. Potgieter, N.P.G. Prinsloo, E.A. Pretorius

(A)VS-Pr.97/1: Teling van braaikuikenhaanlyne. 1962. J.J. Joubert, C.M. Greathead

(A)VS-Pr.97/2: Teling van braaikuikenhenlyne. 1962. J.J. Joubert, C.M. Greathead

VOLSTRUISE/OSTRICHES

VEREDELING/UPGRADING

W-Oh.8/1: Kuddegemiddeldes binne 'n geslote volstruispopulasie, interpretasie daarvan en die beraming van moontlik genetiese parameters vir toekomstige nageslag. D. Swart

W-Oh.8/2: Ondersoek na die variasie in die getal vlerkpluime (witvere) by volstruise. 1974. D. Swart

BESTUUR/MANAGEMENT

W.5353/41/1/1: Testing of chicken shelters for semi-intensive rearing of ostrich chickens in the Karoo and arid regions. 1982. D. Swart

VOEDING/NUTRITION

W.5353/05/2/1: The influence of diet proteins and energy levels on growth and feather production of slaughter ostriches. 1982. D. Swart

Diereprodukte/Animal Products

VLEIS/MEAT

NORMSTUDIES/NORM STUDIES

(A)VS-Pr.76/8: Ontwikkeling van die skeletspiere van verskillende beesrasse. 1973. J.H. Dreyer

(A)VS-Pr.76/9: Fisiologiese aspekte van karkasevaluasie van vleisbeeskruisings. 1975. R.T. Naudé

(A)VS-Pr.76/9: Fisiologiese aspekte van die verkoeling van beeskarkasse. 1976. R.T. Naudé

(A)VS-Pr.76/1: Ontleding van die huidige karkasgraderingstelsel vir beeste. 1976. J.F.G. Klingbiel

(A)VS-Pr.76/12: Produksie en reproduksie van kortskrotumbulle. 1977. R.T. Naudé

(A)VS-Pr.76/2: Liggaamsgroei, samestelling en bouvorm by kleinvee. 1971. R.T. Naudé

(A)VS-Pr.108/1: Invloed van opberging op vleismikrobiologie. 1981

(A)VS-Pr.108/2: Tegnieke vir karkasoppervlakbemonstering. 1981

(A)VS-Pr.76/13: Objektiewe ontleding van die huidige karkasgraderingstelsel vir lammers en skape. 1981

MELK/MILK

CHEMIE-FISIKA/CHEMISTRY-PHYSICS

(A)VS-Pr.46/3: Gehalte van verskillende proteïenfraksies in melk onder sekere gekontroleerde kuddetoestande. 1974. D.J. de Lange

(A)VS-Pr.58/1: Temperatuurstyging van melk gedurende aflewering aan verbruikers. 1970

MIKROBIOLOGIE/MICROBIOLOGY

(A)VS-Pr.32/13: Invloed van voorryping van melk op die bakteriese flora en kwaliteit van Goudakaas. 1977

(A)VS-Pr.58/4: Bakteriologiese gehalte van ultra-hoë temperatuurbehandelde melk. 1978. J.F. Mostert

SUIWELPRODUKTE/DAIRY PRODUCTS

MIKROBIOLOGIE/MICROBIOLOGY

(A)VS-Pr.32/10: Bakteriologiese samestelling van kommersiële suursels vir Goudakaasvervaardiging. 1978. J.F. Mostert

(A)VS-Pr.32/14: Studie van pediococci in Suid-Afrikaanse Goudakaas. 1974

(A)VS-Pr.55/6: Enkele aspekte aangaande die bereiding van magou deur die gebruik van suiwelprodukte. 1978. H. Lück

TEGNOLOGIE/TECHNOLOGY

(A)VS-Pr.32/6: Verkorting van die vervaardigingsproses van Cheddarkaas. 1978. J.A. Niewoudt, J.H. Labuschagne

(A)VS-Pr.32/9: Studies in verband met die insout van Goudakaas in pekeloplossings. 1976

(A)VS-Pr.52/1: Vervaardiging van aangesuurde roombotter. 1975

(A)VS-Pr.55/2: Tegniekstudies in die konsentrering van wei en afgeroomde melk deur middel van ultra-filtrasie. 1972. T.E.H. Dowse

(A)VS-Pr.55/3: Aanwending van die herwinde bestanddele deur ultra-filtrasie in suiwelprodukte. 1972. T.E.H. Dowse

(A)VS-Pr.59/2: Maatstawwe om die graad van rypheid van kaas te bepaal. 1978. J.A. Niewoudt

WOL/WOOL

TEGNOLOGIE/TECHNOLOGY

K-Gf.118/2: Verwering van wol in die Karoostreek. 1976. J.J. Venter

K-Gf.118/4: Gehalteverskille tussen Duerdengetroue, onder- en oorgekartelde Merinowol. 1978. P.D. Grobbelaar

SYBOKHAAR/MOHAIR

TEGNOLOGIE/TECHNOLOGY

K-Gf.104/3: Ouderdomseffekte op die produksie en gehalte-eienskappe van sybokhaar. 1978. J.J. Venter, L. de W. Louw

Ondersteunende Veekundige Navorsing/ Supporting Animal Science Research

VEEVOER/FEEDS

VOEDING/NUTRITION

(A)VS-Pr.93/4: Voedingswaarde van bytsodabehandelde koringstrooi. 1977. T.H. Jansen

(A)VS-Pr.93/5: Inkuiling van braaikuikenmis. 1978. L.H.P. Liebenberg

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(A)VS-Pr.26/7: Onderskeidingstoetse vir melkvervangers. 1977

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(A)VS-Pr.73/12: Invloed van voorafbehandeling van skape op innamebeheer. 1981

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(A)VS-Pr.73/14: Effek van ruvoereienskappe van *Eragrostis curvula*-hooi en sonneblomdoppe op melkproduksie. 1981

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(A)VS-Pr.39/6: Bevriesing van skaapsemen. 1971. A.R. Gee

(A)VS-Pr.76/2: Liggaamsgroei, samestelling en bouvorm by kleinvee. 1971. R.T. Naudé

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(A)VS-Pr.24/2: Hipoplasie by inheemse beesrasse. 1979. E.H.H. Meyer

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Veeartsenykunde/Veterinary Science

BEESTE/CATTLE

PATOLOGIE/PATHOLOGY

OP.341/1/1/1: Immunochemical diagnosis of mastitis in dried-off cows. 1973. W.H. Giesecke

OP.341/1/1/2: Konsentrasie van fibrineuse stowwe in normale en mastitismelk of bies van beeste. 1975. W.H. Giesecke

OP.341/1/1/3: Normale bakteriese flora op beeste se uiers soos beïnvloed deur ouderdom, ras en seisoen. 1979. A.M. du Rand

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OP.341/1/2/2: Vergelyking van verskeie entstowwe teen slenkdalkoors by beeste en skape. 1971. B.J.H. Barnard

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OP.341/1/2/3: Ontwikkeling van hondsdolheidentstof vir beeste en ander diere. 1973. B.J.H. Barnard

OP.341/1/2/4: Rol van buffels in die episoötiologie van bek-en-klouseer van beeste en ander gespleethoewige diere. 1981. G.R. Thomson

OP.341/1/3/1: Vermenigvuldiging van *Cowdria ruminantium* in *Amblyomma hebraeum* van beeste en kleinvee. 1977. J.D. Bezuidenhout

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OP.341/2/1/1: Behandeling van hartglikosiedvergiftigings by beeste. 1979. J.P.J. Joubert

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OP.341/3/1/1: Etiologie, immunologie en patogenese van sweetsiekte by beeste. 1971. J.D. Bezuidenhout

OP.341/3/2/1: Herbesmetting van beeste met bilharzia. 1969. J.A. Van Wyk

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OP.341/3/2/3: Immunologie en serologie van sistiserkose van beeste en varke. 1970. A. Verster

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OP.341/3/2/7: Ontwikkeling van *Fasciola* spp. van beeste en skape in verskillende endgashere. 1978. R. Alves

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OP.341/8/3/1: Kwaliteit, veiligheid en effektiwiteit van Onderstepoort-beesentstowwe teen anaplasmose. 1981. F.T. Potgieter

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OP.342/1/1/1: Kruisimmuniteit tussen verskillende *Pasteurella multocida*-isolate. 1974. C.M. Cameron

OP.342/1/1/2: Immuunkompentensie van die skaap se urinogenitale stelsel teen *Actinobacillus seminis*. 1979. B.C. Jansen

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OP.342/2/1/1: Rol van swamme en plante in die etiologie van geeldikkop in skape. 1971. T.S. Kellerman

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OP.342/3/1/1: Biologie en beheer van *Simulium* spp. by skape in Suid-Afrika. 1968. G.J. Begeman

OP.342/3/2/1: Patologiese fisiologie van *Schistosoma mattheei*-besmetting in skape en beeste. 1969. J.A. van Wyk

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OP.344/5/1/1: Histologie van die dermkanaal van *Sus scrofa domesticus*. 1980. M.S. Myer

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OP.345/1/2/1: Groei en attenuasie van perdesiektevirustipes in selkultuursisteme. 1968. B.J. Erasmus

OP.345/1/2/2: Patogenese van perdesiekte. 1973. S.J. Newsholme

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OP.346/1/1/1: Bereiding van bakterien teen aansteeklike verkoue van pluimvee: hoenders. 1972. S.B. Buys

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VIROLOGIE/VIROLOGY

OP.348/1/1/1: Karakterisering van nuwe orbivirusse. 1973. B.J. Erasmus

OP.348/1/1/2: *In vitro*-aktivering van transkripsieaktiwiteit by bloutongvirus. 1979. A.A. van Dijk

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INSEKTE/INSECTS

TAKSONOMIE/TAXONOMY

OP.3413/1/1/1: Identifikasie en beskrywing van die insekte wat met diere en dieresiektes geassosieer is. 1981. E.M. Nevill

BOSLUISE/TICKS

TAKSONOMIE/TAXONOMY

OP.3414/1/1/1: Identifikasie en beskrywing van die bosluise wat met diere en dieresiektes geassosieer is. 1981. J.B. Walker

OP.3414/1/1/2: Sistematiek van die genus *Rhipicephalus.* 1973. J.B. Walker

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OP.3414/2/1/1: Voorkoms van bestandheid van bosluise teen dipstowwe. 1976. A.M. Spickett

EKOLOGIE/ECOLOGY

OP.3414/3/1/1: Ekologie van *Boophilus decoloratus.* 1976. A.M. Spickett

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OP.3415/1/1/1: Identifikasie en beskrywing van die myte wat met diere en dieresiektes geassosieer is. 1981. P.T. Oberem

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OP.3417/9/1/1: Bepaling van hartglikosiede in bloed, uriene en weefsel van vergiftigde diere. 1972. R.A. Schutz

OP.3417/9/1/2: Chemiese ondersoek van die gifstowwe van *Cynanchum* spp. 1981. G.L. Erasmus

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Diagnostiese Dienste/Diagnostic Services

ALLE DIAGNOSTIESE DIENSTE/ALL DIAGNOSTIC SERVICES

DIAGNOSTIEK/DIAGNOSTICS

OP.3418/1/1/1: Bakteriologiese diagnose van dieresiektes. 1981. M.M. Henton

OP.3418/1/1/2: Diagnose van mastitis as 'n kuddeprobleem in melkbeeste. 1981. W.H. Giesecke

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OP.3418/1/5/1: Makro- en mikroskopiese diagnostiek van patologiese toestande van diere. 1981. J.A.W. Coetzer

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LANDBOUHULPBRONBENUTTING/AGRICULTURAL RESOURCE UTILISATION

HULPBRONKLASSIFIKASIE EN BENUTTINGSNAVORSING/RESOURCE CLASSIFICATION AND UTILISATION RESEARCH

Grondkunde/Soil Science

GROND/SOILS

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(A)S-Pr.53/1: Koördinering van die bemestingsadviesdienste. 1975. A.J. van der Merwe

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(A)S-Pr.55/3: Distribusie en eienskappe van bekalkingsmateriale en afvalprodukte met die oog op geskiktheid vir ameliorasie van R.S.A.-gronde. 1979. H.C.H. Hahne, A. Loock

(A)S-Pr.55/6: Ontwikkeling van X-straal- en termiese tegnieke vir die bepaling van die chemiese samestelling en mineralogiese komponente van kalkmateriale en afvalprodukte. 1979. S.P. Terblanche, R.W. Fitzpatrick, H.C.H. Hahne, J. Zeilhofer

(A)S-Pr.55/5: Silikon-fosfor-seskwioksiedverwantskappe met die oog op ameliorering van suurgronde met silikaat. 1979. H.C.H. Hahne, A. Loock

(A)S-Pr.51/1: Ontwikkeling van veld- en laboratoriummetodes vir die evaluering en voorspelling van waterbeweging in 'n reeks Suid-Afrikaanse gronde. J.L. Hutson, B.J. Joubert, H.M. du Plessis

(A)S-Pr.43/1: Struktuurstabiliteit van Suid-Afrikaanse gronde. 1972. J.L. Hutson

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(A)S-Pr.61/2: Effek van kaneel- en bensoësuurderivate op die wortelontwikkeling en voedingstofopname van gewasse. 1980. A.J. van der Merwe

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Landbouweerkunde/Agrometeorology

KLIMAAT/CLIMATE

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Grondbewaring/Soil Conservation

EROSIE/EROSION

STABILISERING VAN SLOTE/STABILISATION OF DONGAS

(A)L-MI.23/1: Stabilisering van slote: stabilisering met plantegroei, ondersteun deur klein meganiese strukture (Nuwejaarspruit). 1969. A.H. McNaughton

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(A)L-MI.55/1: Evaluasie van ingenieursfasette van ondergrondse dreineerstelsels: evaluasie van moderne dreineringsteorie vir die ontwerp van ondergrondse dreineerstelsels in die Winterreënstreek. 1978. R.P. Perold

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OK-VI.14/15: Oorreding van boere tot korrekte benutting van Staats- en meerdere grondbewaringswerke in Queenstown. 1979. I.W. van der Merwe

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EROSIEBEHEER/EROSION CONTROL

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PLAASBEPLANNING

AFKAMPING EN BEHANDELING VAN EROSIE/CAMPING OFF AND CONTROL OF EROSION

OK-Vl.14/5: Beskerming van bewerkte grond teen erosie in die voorligtingswyk van Stutterheim. 1973. B. Hill

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WEIDINGKUNDIGE STUDIES IN VERBAND MET EROSIEBEHEER/PASTURE STUDIES FOR CONTROL OF EROSION

H-Ps.254/1: Voorlopige evaluering van verskillende grasse vir aanplanting vir erosiebeheer op waterbane op 'n Huttongrond. 1976. C.S. Dannhauser

H-Ps.254/2: Evaluering van 'n aantal grasse vir aanplanting vir erosiebeheer op 'n waterbaan op 'n Avalongrond in die Oos-Vrystaat. 1978. C.S. Dannhauser

PLAASBEPLANNING/FARM PLANNING

FISIESE BEPLANNING/PHYSICAL PLANNING

OK-Vl.13/7: Beplanning van plase in die voorligtingswyk van Barkly-Oos. 1973. J.S.J. Jordaan

OK-Vl.13/13: Beplanning van plase in die voorligtingswyk van Aliwal-Noord. 1973. O.V. Loest

OK-Vl.13/17: Beplanning van plase in die voorligtingswyk van Dordrecht. 1973. D.W. Schoeman

OK-Vl.13/20: Beplanning van plase in die voorligtingswyk van Molteno. 1973. D.W. Schoeman

Voorskrifgrondbewaringswerke/Prescribed Soil Conservation Works

EROSIEBEHEER/EROSION CONTROL

STELSELONTWERP/SYSTEMS DESIGN

W-Vl.14/3:	Erosiebeheer deur kontoerwalle - Bo-Langkloof. 1974. C.J. Meiring.
W-Vl.14/4:	Erosiebeheer deur kontoerwalle - Caledonwyk. 1974. P.R. Visser
W-Vl.14/7:	Erosiebeheer deur kontoerwalle - Heidelberg-Riversdal. 1974. J. Kemp
W-Vl.14/8:	Erosiebeheer deur kontoerwalle - Swellendamwyk. 1974. J.P. Pietersen
W-Vl.14/9:	Erosiebeheer deur kontoerwalle - Bredasdorpwyk. 1975. P.R. Visser
W-Vl.14/23:	Erosiebeheer deur kontoerwalle - Montaguwyk. 1977. D.J. de Wit
W-Vl.14/6:	Erosiebeheer deur kontoerwalle - Hartenbosdamopvanggebied. 1972. D.J. Windsor
W-Vl.14/19:	Erosiebeheer deur kontoerwalle - Tulbaghwyk. 1973. F.J. Saaiman
W-Vl.14/1:	Erosiebeheer deur kontoerwalle - Cereswyk. 1971. F.J. Saaiman
W-Vl.14/18:	Afleibaanbeskerming - Wellingtonwyk. 1973. C.J. Watts
W-Vl.14/10:	Afleibaanbeskerming - Durbanvillewyk. 1975. H.F.O. Bekker
W-Vl.14/21:	Waterafloopopnamebeheer - Outeniqualand. 1976. J.H. Blomerus
W-Vl.14/17:	Winderosiebestryding - Graafwatergebied. 1975. M.J. Swanepoel
W-Vl.14/15:	Winderosiebestryding - Hopefield-Vredenburggebied. 1974. W.W. Burger

LANDBOUPRODUKSIE-EKONOMIE/AGRICULTURAL PRODUCTION ECONOMICS

Produksiefaktorverwerking/Production Factor Processing

GROND/SOIL

METODIEKE EN NORME VIR BEREKENING VAN OPTIMUM PLAASGROOTTES
METHODOLOGY AND NORMS FOR CALCULATION OF OPTIMUM FARM SIZES

	Riglyne vir die beplanning van 'n ekonomies uitvoerbare besproeiings-onderneming.
	Bepaling van perseelgroottes met die oog op die beplanning van besproeiing-skemas.
PE.5612/48/2/5:	The economic advantage for agriculture generated by the proposed improvements to the water distribution system at Duiwenhoksrivier. 1982. J. van Zyl
PE.5612/48/2/6:	The economic implications of mineralisation and water restrictions in the Vaal River irrigation area. 1982. J. van Zyl
PE.5612/48/2/7:	Calculation of the economic advantage for agriculture generated by the planned pump station in the proposed Rooiberg irrigation district. 1982. J. van Zyl

INFRASTRUKTUUR

PE.5612/48/2/8: The determination of economically viable farm units in the Blouberg area. 1982. J. van Zyl

PE.5612/48/2/9: Calculation of the economic advantage for agriculture generated by the proposed Neusburg-Augrabies irrigation development. 1982. J. van Zyl

BEPALING VAN GRONDWAARDES/DETERMINATION OF LAND VALUE

Waardasie van landbougrond en riglyne ten opsigte van markwaarde en landbouwaarde van grond.

HUUR EN VERHURING VAN LANDBOUGROND/LEASING OF AGRICULTURAL LAND

Bepaling van parameters om realistiese huurtariewe te beraam.

KAPITAAL/CAPITAL

FINANSIERING/FINANCING

Finansieringsnorme vir boerderye in die Noord- en Noordwes-Transvaalse bosveld.

ARBEID/LABOUR

ARBEIDSAANWENDING, -VERGOEDING EN -BENUTTING/LABOUR EMPLOYMENT, COMPENSATION AND UTILISATION

'n Tyd- en bewegingstudie ten opsigte van die aanwending van arbeid by die produksie van oriëntale tabak.

BESTUUR/MANAGEMENT

OPTIMALE BENUTTING VAN PRODUKSIEFAKTORE/OPTIMAL USE OF PRODUCTION FACTORS

Doeltreffendheidsevaluering van deeltydse boere in die Noordwes-Transvaalse bosveld.

Bepaling van die omvang, aard en doeltreffendheid van deeltydse boerderye in die R.S.A.

INFRASTRUKTUUR/INFRASTRUCTURE

ENERGIEVOORSIENING EN -BENUTTING IN DIE LANDBOU/ENERGY PROVISION AND UTILISATION IN AGRICULTURE

Koste van elektriese krag op plase.

Bedryfsopnames/Enterprise Surveys

PRODUKSIEKOSTE-OPNAMES/PRODUCTION COST SURVEYS

AKKERBOU- EN WEIDINGSGEWASSE/FIELD AND PASTURE CROPS

Produksiekoste van somergrane en oliesade in drie gebiede.

Produksiekoste van koring in drie gebiede.

Boerderybestuurstegnieke/Farming Management Techniques

INKOMSTE- EN KOSTEBERAMINGS/INCOME AND COST RATINGS

METODES, INSAMELING EN OPSTELLING/METHODS, COLLECTION AND COMPILATION

Navorsing insake die opstelling en rekenarisering van inkomste- en kosteramings.

Inkomste- en kosteramings ten opsigte van indiwiduele vertakkings.

Meganisasie- en verbeteringskosteramings.

BESTUURSTEGNIEKE/MANAGEMENT TECHNIQUES

ONTWIKKELING EN GEBRUIKSWAARDE/DEVELOPMENT AND APPLICATION VALUE

Die bestudering van geïdentifiseerde bestuursprobleme by geselekteerde varsmelkprodusente.

Plaasbedryfsleer met posrekords as brondata.

Boerderyrekords/Farming Records

POSREKORDS/POSTAL RECORDS

EKONOMIE/ECONOMICS

N-Vl.23/1: Improvement of business management of farmers in the Natal Region through the use of economic record keeping systems. 1981. R. Bischof

ALTERNATIEWE/ALTERNATIVES

Ontwikkeling van 'n veelfasige posrekordstelsel (Agrirep-stelsel).

SITUASIEBEPALING/POSITION DETERMINATION

W-Vl.17/30: Posrekords - Bredasdorpwyk. 1973. D. Cronje

W-Vl.17/31: Posrekords - Caledonwyk. 1977. J.N. Kotzé

W-Vl.17/38: Posrekords - Warm-Bokkeveld, Ceres. 1974. W.F. Marais

W-Vl.17/39: Posrekords - Koue-Bokkeveld, Ceres. 1974. W.F. Marais

W-Vl.17/35: Posrekords - Worcesterwyk. 1976. G.G. van der Merwe

W-Vl.17/21: Posrekords - Koebergsuiwelbedryf. 1975. H.F.O. Bekker

NASSELLA

KONVENSIONELE REKORDS/CONVENTIONAL RECORDS

ALTERNATIEWE/ALTERNATIVES

Opstelling van 'n gevorderde finansiële boekhouboek vir boere

Inligtingstelsels/Information Systems

HANDBOEKE/TEXT BOOKS

OPSTELLING/COMPILATION

Inhoudsaspekte van 'n standaardhandboek as boerderybestuursinligtingstelsel.

OPLEIDING/TRAINING

KOMMUNIKASIE/COMMUNICATION

Vakkundige kommunikasie en indiensopleiding in belang van landbou in Suid-Afrika.

ONKRUIDBEKAMPING/COMBATTING OF WEEDS

Onkruidbestryding/Weed Control

DIVERSE ONKRUIDE/SUNDRY WEEDS

BEHEER/CONTROL

N-VI.25/1: Control of American bramble (*Rubus cuneifolius*) in Bioclimate group 4 in the Howick and Richmond extension wards. 1981. R.M. Webster

OORREDING/PERSUASION

W.6473/39/1/1: Artificial pastures: The persuasion of farmers in the crop producing areas of the Winter Rainfall Region to prevent rye grass poisoning. 1982. J.H. Blomerus

NASSELLA

GEWASKUNDE/CROP SCIENCE

W-Sb.159: Bestryding van nassella-polgras in die Winterreënstreek. 1979. D.J. le Roux

BESTRYDING/CONTROL

OK-VI.13/8: Loodsing van bestrydingsprogram vir nassella in die voorligtingswyk Barkly-Oos. 1972. J.S.J. Jordaan

ONDERNEMERSONTWIKKELING/ENTREPRENEUR DEVELOPMENT

VOORLIGTINGSDIENSTE/EXTENSION SERVICES

Geprogrammeerde Voorligting/Programmed Extension

MELKBEESTE/DAIRY CATTLE

VERBETERING DEUR OORREDING/PROMOTION BY PERSUASION

N-Vl.18/2: Promotion of fodder planning to meet the dry matter requirements of dairy herds in the Howick extension area throughout the year. 1981. R.M. Webster

DURUM

OORREDING VAN BOERE/PERSUASION OF FARMERS

K-Vl.19/1: Oorreding van boere tot hoër durumkoringproduksie in die Visriviervallei. 1980. P.S. van Heerden

NASSELLA

OORREDING VAN BOERE/PERSUASION OF FARMERS

K-Vl.20/1: Oorreding van boere om nassellapolgras uit te roei in die voorligtingswyk Somerset-Oos. 1980. J.C. van Aardt

K-Vl.20/2: Oorreding van boere om nassellapolgras uit te roei in die voorligtingswyk Graaff-Reinet. 1980. I.J. Conradie

REGULATORIESE BEHEER/REGULATORY CONTROL

OORREDING VAN BOERE/PERSUASION OF FARMERS

K-Vl.21/1: Oorreding van oortreders van die Grondbewaringswet in die voorligtingswyk Cradock. 1981. C.S. Wessels

K-Vl.21/2: Oorreding van oortreders van die Grondbewaringswet in die voorligtingswyk Graaff-Reinet. 1981. I.J. Conradie

K-Vl.21/8: Oorreding van oortreders van die Grondbewaringswet in die voorligtingswyk Middelburg, K.P. 1981. J.D. Blom

ATRIPLEX

OORREDING VAN BOERE/PERSUASION OF FARMERS

K-Vl.22/8: Oorreding van boere om droogtevoergewasse (*Atriplex*) aan te plant in die voorligtingswyk Middelburg, K.P. 1981. M.J.A. Coetsee

K-Vl.22/14: Oorreding van boere om droogtevoergewasse (*Atriplex*) aan te plant in die voorligtingswyk Fraserburg. 1981. C.B. Reitz

HULPBRONNE EN TEGNOLOGIE

PRODUKSIESTELSELS/PRODUCTION SYSTEMS

ONTWIKKELING EN BEVORDERING/DEVELOPMENT AND PROMOTION

O-VI.12/1: Produksietegnieke- en opbrengsnormestudies in die voorligtingswyk Zastron. 1974. W.D. Jonker

O-VI.12/12: Evaluering van die produksiestelsels in die Kalahari-duineveld op die plaas Massakloutjie. 1977. N.J. de Wet

O-VI.13/1: Demonstrasie van verbeterde mielieproduksiepraktyke op Vaalharts ten opsigte van planttye, plantpopulasies, cultivars en besproeiingskedulering. 1980. H. Hamman

O-VI.13/2: Demonstrasie van verbeterde koringproduksiepraktyke op Vaalharts ten opsigte van spasiëring en besproeiingskedulering. 1981. H. Hamman

HULPBRONNE EN TEGNOLOGIE/RESOURCES AND TECHNOLOGY

OORREDING VAN BOERE/PERSUASION OF FARMERS

T-VI.39/1: Oorreding van boere tot optimale hulpbronbenutting in die Sabievallei-besproeiingsgebied. 1975. C.C. Engelbrecht

T-VI.39/2: Oorreding van boere tot optimale hulpbronbenutting in die Kendal-akkerbougebied. 1975. J.W. Filter

T-VI.39/3: Oorreding van boere tot optimale hulpbronbenutting in die Koedoesrand-veeboerderygebied.

T-VI.39/4: Oorreding van boere tot optimale hulpbronbenutting in die Kostersaaigebied. 1979. T.J. Barnard

T-VI.39/5: Oorreding van boere tot optimale hulpbronbenutting in die Strydomblokbesproeiingsgebied. 1979. P.J. du Toit

T-VI.39/6: Oorreding van boere tot optimale hulpbronbenutting in die ekstensiewe skaapweigebiede van Belfast. 1979. J.S. Leonard

T-VI.39/7: Oorreding van die varsmelkprodusente van Pietersburg tot optimale hulpbronbenutting. 1980. S.E. Terblanche

T-VI.39/8: Oorreding van boere tot optimale hulpbronbenutting in die ekstensiewe veeboerderygebiede van Volksrust. 1980. H.P. Scholtz

T-VI.39/9: Oorreding van boere tot optimale hulpbronbenutting in die Letababosveldgebied. 1977. W.B. Noel

T-VI.39/10: Oorreding van die avokadoprodusente van Tzaneen tot optimale hulpbronbenutting. 1978. I.J. van Rensburg

ORGANISATORIESE STRUKTUUR VIR LANDBOU-ONTWIKKELING/ORGANISATIONAL STRUCTURE FOR AGRICULTURAL DEVELOPMENT

T-VI.39/1/1: Skep van 'n organisatoriese struktuur vir Thabazimbivoorligtingswyk. 1978

AFLOOPBEHEER IN DIE TRANSVAALSTREEK/RUN-OFF CONTROL IN THE TRANSVAAL REGION

T-VI.34/2: Afloopbeheer in die Sabievalleigebied. 1975

T-VI.34/3: Afloopbeheer in die Kendalgebied. 1975

T-Vl.34/4: Afloopbeheer op die Noordoos-Springbokvlakte. 1980

T-Vl.34/5: Afloopbeheer in die Kafferspruitgebied. 1970

T-Vl.34/6: Afloopbeheer in die Groot Olifantsgebied. 1975

T-Vl.34/7: Afloopbeheer in die Bokkraalgebied. 1981

T-Vl.34/8: Afloopbeheer in die Klein Komatigebied. 1981

T-Vl.34/9: Afloopbeheer in die Almagebied. 1974

T-Vl.34/10: Afloopbeheer in die Vlooikopgebied. 1977

T-Vl.34/11: Afloopbeheer in die Badplaaskomgebied. 1975

T-Vl.34/12: Afloopbeheer in die Annysspruitgebied. 1975

T-Vl.34/14: Afloopbeheer in die Bokpoortgebied. 1975

Ad hoc-advies/Ad hoc Advice

BOERDERYREKORDS/FARMING RECORDS

DATAPROSESSERING/DATA PROCESSING

N-Vl.24/1: Dairy herd records. 1981. R.I. Jones

GROND-PLANTONTLEDING/SOIL-PLANT ANALYSIS

KOöRDINERING VAN GROND-PLANT-WATERANALISE/CO-ORDINATION OF SOIL-PLANT-WATER ANALYSIS

N-Ce.149/1: Soil analysis services. 1978. R.J. Bennet

N-Ce.149/2: Analysis of diverse fodder crops. 1979. R.J. Bennet

WINGERDBOU/VITICULTURE

OORREDING VAN BOERE/PERSUASION OF FARMERS

W-Vl.17/14: Wingerdverbouing - Ladismith. 1972. M.J. de W. Delport

W-Vl.17/12: Wingerdverbouing - Montaguwyk. 1973. W.J. Basson

KLEINGRAAN/SMALL GRAIN

OORREDING VAN BOERE/PERSUASION OF FARMERS

W-Vl.17/25: Kleingraanverbouing - Caledonwyk. 1976. J.N. Kotze

W-Vl.17/9: Kleingraanverbouing - Swellendamwyk. 1973. J.P. Pietersen

W-Vl.17/26: Kleingraanverbouing - Montaguwyk. 1973. W.J. Basson

W-Vl.17/28: Kleingraanverbouing - Bredasdorpwyk. 1972. D. Cronje

WEIDING/PASTURES

OORREDING VAN BOERE/PERSUASION OF FARMERS

W-Vl.16/2: Weiveldverbetering - Ladismithgrondbewaringsdistrik. 1973. A.A. Schoeman

W-Vl.16/3: Weiveldverbetering - Montaguwyk. 1973. E.J.J. Nel

W-Vl.16/4: Weiveldverbetering - Uniondalewyk. 1974. C.J. Nel

W-Vl.16/9: Weiveldverbetering - Klein Karoo. 1976. L.E. Nolte

W-Vl.16/10: Aangeplante weidings - Mosselbaaigebied. 1976. W.G.J. Voigt

W-Vl.16/12: Aangeplante weidings - Touwsrivier. 1978. E.J.J. Nel

W-Vl.16/14: Aangeplante weidings - Langkloofgebied. 1978. B.F.A. Visser

W-Vl.16/8: Aangeplante weidings - Stellenboschwyk. 1975. B.F. Smit

STELSELMODELLERING/SYSTEMS MODELLING

NATALSTREEK/NATAL REGION

N-Ce.139/1: Beef feeding simulator for extension use. 1975. B.J. Lyle

N-Ce.139/2: Dairy enterprise simulator. 1975. R.M. Bredon

N-Ce.139/3: Beef breeding herd simulator. 1976. B.J. Lyle

N-Ce.139/5: Linear programme forage crop production planning. 1977. R.I. Jones

N.Ce.139/4: Run-off and soil loss estimation model. 1976. W.B. Russell

OPLEIDING/TRAINING

Landboukolleges/Colleges of Agriculture

SITUASIEBEPALING/SITUATIONAL ANALYSIS

H.6126/36/1/1: Factors that influence the underachievement of first-year students at colleges of agriculture. 1983. L.I. de Waal

LANDBOU-ENERGIE/AGRICULTURAL ENERGY

Energie/Energy

BRANDSTOF/FUEL

ALTERNATIEWE BRANDSTOWWE/ALTERNATIVE FUELS

(A)L-MI.60/1: Ingenieurkundige ondersoek na die aanwendingsmoontlikhede van alternatiewe brandstowwe in die landbou. 1979. F.J.C. Hugo

WEIDINGSBENUTTING EN BOTANIESE NAVORSING/ PASTURE UTILISATION AND BOTANICAL RESEARCH

WEIDINGSBENUTTINGSNAVORSING: BOSVELDGEBIED/ PASTURE UTILISATION RESEARCH: BUSHVELD AREA

Natuurlike Weidings/Natural Pastures

VELDWEIDINGS/VELD PASTURES

ONTGINNING VAN DIE PRODUKSIEPOTENSIAAL VAN NATUURLIKE WEIDINGS IN DIE VRYSTAATSTREEK/RECLAMATION OF THE PRODUCTION POTENTIAL OF THE NATURAL PASTURES IN THE ORANGE FREE STATE REGION

O-Gl.141/3: Evaluasie van die produksiepotensiaal van kalkveld in die noordoostelike gebied van die Ghaapse plato. 1977. J.H. Fourie

O-Gl.144/2: Vergelykende studie van twee produksiestelsels in die Noord-Kaap. 1978. J.H. Fourie

VELDBESTUUR IN DIE TRANSVAALSTREEK/VELD MANAGEMENT IN THE TRANSVAAL REGION

T-Vl. 35/1/1: Uitwerking van verskillende bestuurspraktyke op die natuurlike veld van die bosveld in die Thabazimbigebied. 1981. D. Grossman

Meerjarige Aangeplante Weidings/ Perennial Cultivated Pastures

ANTHEPHORA

BEPALING VAN DIE POTENSIAAL VAN MEERJARIGE AANGEPLANTE WEIDINGS IN DIE VRYSTAATSTREEK/DETERMINATION OF THE POTENTIAL OF THE PERENNIAL CULTIVATED PASTURES IN THE ORANGE FREE STATE REGION

O-Gl.147/1: Ekotipe-evaluasie by twee bemestingspeile op grond van die Manganoserie. 1976. J.H. Fourie

O-Gl.147/2: Ekotipe-evaluasie by twee bemestingspeile op 'n grond van die Annandaleserie te Vryburg. 1976. J.H. Fourie

O-Gl.147/3: Ekotipe-evaluasie by twee bemestingspeile op grond van die Sunburyserie te Vergeleë. 1976. J.H. Fourie

O-Gl.147/4: NPK-bemestingsproef met *Anthephora*. 1976. J.H. Fourie

O-Gl.147/5: Reaksie van vyf ekotipes van *Anthephora* op beweiding. 1977. J.H. Fourie

LUSERN/LUCERNE

GEWASKUNDE/CROP SCIENCE

V.5414/30/1/1: An investigation of the adaptability of lucerne cultivars which are resistant to the blue-green aphid and pea aphid under irrigation at Vaalharts. 1982. J.P. van Niekerk

CYNODON

AANGEPLANTE WEIDINGS/CULTIVATED PASTURES

BEPALING VAN DIE POTENSIAAL VAN MEERJARIGE AANGEPLANTE WEIDINGS IN DIE VRYSTAATSTREEK/DETERMINATION OF THE POTENTIAL OF THE PERENNIAL CULTIVATED PASTURES IN THE ORANGE FREE STATE REGION

O-Gl.143/2: Voorlopige waardebepaling van die weidingsplante vir die bosveldgebied in Noord-Kaapland. 1974. J.H. Fourie

WEIDINGSBENUTTINGSNAVORSING: HOë-POTENSIAALGEBIED/PASTURE UTILISATION RESEARCH: HIGH POTENTIAL AREA

Natuurlike Weiding/Natural Pastures

VELDWEIDINGS/VELD PASTURES

PRODUKSIEPOTENSIAAL/PRODUCTION POTENTIAL

N-Th.3/1: Veld burning and mowing in Bioclimate area 4e. 1946. B.D. Mappledoram

N-Th.3/2: Regrowth rates of veld in spring. 1980. P.C.V. du Toit

N-Ce.115/23: Beef steers in six stocking rates on sandy sourveld. 1981. P.C.V. du Toit

N-Ce.120/1: Soil-inhabiting insects damaging veld pastures. 1970. P.C. Joubert

OK-Do.50/8: Stocking density and species and area selection. 1972. T. Daines

Meerjarige Aangeplante Weidings/Perennial Cultivated Pastures

ACROCERAS

CULTIVARONTWIKKELING/CULTIVAR DEVELOPMENT

N-Ce.119/5: Selection and breeding of *Acroceras macrum* in Bioclimate area 3. 1970. J.M.L.C. Rhind

CYNODON

WEIDINGSKALIBRASIE/PASTURE CALIBRATION

N-Th.16/10: *Cynodon* cultivar trial in Bioclimate area 6. 1972. B.D. Mappledoram

N-Th.16/37: Stargrass cultivar trial with grazing (Phase II) on Estcourt soil in Bioclimate area 8. 1978. B.D. Mappledoram

N-Th.16/38: Stargrass cultivar trial with grazing (Phase II) on Avalon soil in Bioclimate area 8. 1978. B.D. Mappledoram

N-Th.16/39: Stargrass cultivar trial with grazing (Phase II) on Uitvlugt soil in Bioclimate area 8. 1978. B.D. Mappledoram

DIGITARIA

CULTIVARONTWIKKELING/CULTIVAR DEVELOPMENT

N-Ce.134/1: Selection and breeding of *Digitaria eriantha* in Bioclimate area 4. 1974. A. Smith

WEIDINGSBESTUUR/PASTURE MANAGEMENT

N-Ce.115/2: Effect of stocking rate and nitrogen fertiliser on the performance of steers on *Digitaria smutsii* and *Eragrostis curvula* legume in Bioclimate area 4f. 1981. G.M. Brockett

ERAGROSTIS

CULTIVARONTWIKKELING/CULTIVAR DEVELOPMENT

N-Ce.102/1: Selection and breeding of *Eragrostis curvula* in Bioclimate area 3. 1970. J.M.L.C. Rhind

WEIDINGSVOEDING/PASTURE NUTRITION

N-Dd.6/3: Phosphate and potash requirements of *Eragrostis curvula* on a leksand Bioclimate area 8. 1972. P.E. Bartholomew

N-Ec.20/1: N,P,K and lime for *Eragrostis curvula* in Bioclimate area 6. 1971. P.E. Bartholomew

WEIDINGSKALIBRASIE/PASTURE CALIBRATION

N-Ec.10/4: *Eragrostis curvula* cultivar trial on Clovelly soil in Bioclimate area 4e. 1968. B.D. Mappledoram

N-Th.16/17: *Eragrostis curvula* and *Acroceras macrum* cultivars for hay in Bioclimate area 4e. 1972. B.D. Mappledoram

WEIDINGSBESTUUR/PASTURE MANAGEMENT

N-Ec.12/5: Characterisation of *Eragrostis curvula* with the grazing animal in Bioclimate area 4f. 1976. G.M. Brockett

KIKOEJOE/KIKUYU

VESTIGING EN EKOLOGIESE STUDIES/ESTABLISHMENT AND ECOLOGICAL STUDIES

N-Th.16/43: Growth and development of kikuyu. 1981. P.C.V. du Toit

N-Ec.20/3: Nutrition requirements of established kikuyu response to topdressed nutrients. 1981. N. Miles

N-Th.16/36: Legumes suitable for kikuyu pasture in Bioclimate area 3. 1976. C.I. MacDonald

N-Th.16/45: Management of red clover in kikuyu pastures in Bioclimate area 3. 1981. C.I. MacDonald

TRIFOLIUM

VOEDING/NITRITION

N.5443/05/1/9: Response of kikuyu to phosphorus, calcium and magnesium on a highly leached soil in the moist Highland sourveld. 1982. N. Miles

N.5443/05/1/8: Response of kikuyu to nitrogen, phosphorus and lime on a highly leached soil in the moist Highland sourveld. 1982. N. Miles

WEIDINGSBESTUUR/PASTURE MANAGEMENT

N-Ce.151/1: Making kikuyu grass silage. 1979. J.K. Arnott

LOLIUM

CULTIVARONTWIKKELING/CULTIVAR DEVELOPMENT

N-Ce.147/2: Selection and breeding of *Lolium perenne* in Bioclimate area 3. 1978. J.M.L.C. Rhind

N-Ce.134/4: Evaluation of *Lolium multiflorum* cultivars at various planting dates in Bioclimate area 3. 1978. D.C.W. Goodenough

VESTIGING EN EKOLOGIESE STUDIES/ESTABLISHMENT AND ECOLOGICAL STUDIES

N-Ce.122/5: Seed production from *Lolium multiflorum*. 1981. D.C.W. Goodenough

WEIDINGSBESTUUR/PASTURE MANAGEMENT

N-Ce.115/25: Effect of stocking rate on the performance of weaners on irrigated *Lolium multiflorum* in Bioclimate area 3. 1979. P.E. Bartholomew

TRIFOLIUM

CULTIVARONTWIKKELING/CULTIVAR DEVELOPMENT

N-Ce.140/1: Selection and breeding of *Trifolium* in Bioclimate area 3. 1977. A. Smith

VESTIGING EN EKOLOGIESE STUDIES/ESTABLISHMENT AND ECOLOGICAL STUDIES

N-Ce.122/6: Seed production from *Trifolium repens*. 1981. A. Smith

WEIDINGSVOEDING/PASTURE NUTRITION

N-Ce.108/7: Phosphate and lime nutrition of *Trifolium/Fescue* pasture on dystrophic soils of Bioclimate area 3. 1976. P.E. Bartholomew

N-Ce.108/8: Phosphate and lime nutrition of *Trifolium* pasture on dystrophic soils in Bioclimate area 3. 1976. P.E. Bartholomew

N-Ce.117/1: Selection of *Rhizobium* strains for *Trifolium* in Bioclimate areas 3, 4 and 4f.

N-Ce.146/2: Screening *Trifolium* species for *Mycorrhiza* in Bioclimate area 3. 1978. A. Smith

WEIDINGSKALIBRASIE/PASTURE CALIBRATION

N-Th.16/40: *Trifolium pratense* cultivar trial in Bioclimate area 4e. 1978. B.D. Mappledoram

AANGEPLANTE WEIDINGS/CULTIVATED PASTURES

WEIDINGSBESTUUR/PASTURE MANAGEMENT

A.W-Rd.1/1: Bepaling van inentingsvereistes van weidings- en voerpeulgewasse. 1977. V.D. Wassermann

A.W-Rd.1/2: Bepaling van daglengte- en temperatuurvereistes vir normale blomvorming van weidings- en voerpeulgewasse. 1978. V.D. Wassermann

A.W-Rd.2/1: Kwekerystudies met weidings- en voerpeulgewasse op Rietondale. 1978. A.J. Kruger

A.W-Rd.2/2: Opbrengsproewe met tropiese en subtropiese weidings- en voerpeulplante. 1978. A.J. Kruger

A.W-Rd.2/3: Opbrengsproewe met koelweerpeulgewasse. 1978. A.J. Kruger

N-Th.16/9: Plant material centre in Bioclimate area 6. 1972. B.D. Mappledoram

N-Th.16/16: Plant materials sub-centre in Bioclimate area 4e. 1972. B.D. Mappledoram

N-Ce.111/25: Strip replacement of Ngongoni veld in Bioclimate area 3. 1978. P.J. Edwards

N-Ce.132/4: Animal production from Coastcross 2 under different management systems in Bioclimate area 2. 1976. G.M. Brockett

N-Ec.12/7: *Dactylis glomerata* with and without legume at two stocking rates in Bioclimate area 3. 1979. P.J. Edwards

N-Ec.17/15: Cows and calves on various forms of radical veld improvement in Bioclimate area 4e. 1973. P.J. Edwards

N-Th.16/23: Steers on stargrass at three stocking rates in Bioclimate area 6. 1972. P.J. Edwards

N-Ce.115/22: Effect of stocking rate and nitrogen fertiliser on the performance of hammels on various pastures on upland and bottomland in Bioclimate area 4f. 1981. G.M. Brockett

OK-Do.63/20: Evaluering van Rhodesgras vir beesvleisproduksie in die Alexandria-Bathurstgebied. 1980. T. Daines

CULTIVARONTWIKKELING/CULTIVAR DEVELOPMENT

N-Ce.147/1: Selection and breeding of *Festuca arundinacea* in Bioclimate area 3. 1978. J.M.L.C. Rhind

N-Ce.146/3: Use of tissue and anther culture to obtain homozygous breeding lines in white clover. 1981. C.F. Smith

N-Ce.30: Selection and breeding of *Paspalum dilatatum* in Bioclimate area 3. 1959. J.M.L.C. Rhind

N-Ce.33: Selection and breeding of *Dactylus glomerata* in Bioclimate area 3. 1959. J.M.L.C. Rhind

GEWASKUNDE/CROP SCIENCE

N.5443/30/6/2: Planted pastures: making Italian rye grass silage. 1983. J.K. Arnott

VESTIGING EN EKOLOGIESE STUDIES/ESTABLISHMENT AND ECOLOGICAL STUDIES

N-Ce.111/24: Evaluation of *Pennisetum clandestinum* selections for cold tolerance and resistance to "yellows" in Bioclimate areas 3, 4e and 4f. 1977. J.K. Arnott

VOEDING/NUTRITION

N-Ce.132/3: Effect of various levels of N, P and K on productivity of Coastcross 2 in Bioclimate area 3. 1973. P.E. Bartholomew

N-Ec.20/2: *Pennisetum clandestinum* response to N, P and lime on highly weathered soils. 1980. N. Miles

A.W-Rd.1/4: Study of the effects of N-fertiliser on the productivity of white clover pasture. 1981. G. Heyns

N.5443/05/11: Response of white clover to phosphorus, sulphur, molybdenum and lime on a highly leached soil in the moist Highland sourveld. 1983. N. Miles

WEIDINGSKALIBRASIE/PASTURE CALIBRATION

N-Ce.142/1: *Dactylis glomerata* cultivar trial in Bioclimate areas 3, 4 and 6. 1977. B.D. Mappledoram

N-Ce.142/2: *Festuca arundinacea* cultivar trial in Bioclimate areas 3, 4 and 6. 1978. B.D. Mappledoram

N-Th.16/32: Classification, processing and assessment of available pasture data in Natal. 1976. G.M. Brockett

N-Ec.12/6: Foggage value of pastures in Bioclimate area 3. 1978. J.K. Arnott

N-Ec.12/8: Foggage value of pastures in Bioclimate area 4f. 1981. N. Gray

N-Ec.12/9: Temperate pastures under irrigation in Bioclimate area 4e. 1980. T.M. du Plessis

N-Ec.12/10: Effect of site on production of pasture species in Bioclimate area 3. 1980. J.K. Arnott

N-Th.16/26: Comparison of various tropical grasses and legumes on a Doveton soil in Bioclimate area 4f. 1973. N. Gray

N-Th.16/27: Comparison of various tropical grasses and legumes on an Arrochar soil in Bioclimate area 4f. 1973. G.M. Brockett

POTENSIAALBEPALING/POTENTIAL DETERMINATION

OK-Do.63/6: Instandhouding en uitbouing van die kwekery te Dohne. 1975. J. Hoffman

OK-Do.63/7: Instandhouding en uitbouing van die kwekery te Bathurst. 1976. T. Daines

OK-Do.63/8: Evaluering van weidingspesies vir veldversterking in die Dohne-suurveld. 1976. C.J.G. le Roux

OK-Do.63/11: Groeipatroon van stergras in die kusgebied noordoos van Oos-Londen. 1976. A.J. Aucamp

OK-Do.63/12: Groeipatrone van somergrasse in die Albax-area. 1977. T. Daines

OK-Do.63/13: Groeipatrone van gematigde grasse in die Albax-area. 1976. T. Daines

OK-Do.63/14: Groeipatrone van somergrasse in die Dohne-suurveld. 1979. C.J.G. le Roux

OK-Do.63/15: Groeipatrone van gematigde grasse in die Dohne-suurveld. 1979. C.J.G. le Roux

OK-Do.63/16: Growth and production of summer grasses in the coastal belt north-east of East London. 1981. L.O. Nel

OK-Do.63/17: Growth and production of temperate grasses in the coastal belt north-east of East London. 1981. L.G. Howe

OK-Do.63/18: Potential of legumes for the coastal belt north-east of East London for red meat production. 1980. C.J.G. le Roux

OK-Do.63/19: Screening of annual legumes in the Albany/Alexandria area. 1980. T. Daines

OK-Do.63/21: Screening annual temperate legumes in the Dohne Sourveld. 1980. C.J.G. le Roux

OK-Do.63/22: Screening of perennial legumes in the Dohne Sourveld. 1980. C.J.G. le Roux

OK-Do.63/24: The phytomass potential of Rhodes grass on a Shorrocks series soil at Bathurst at various nitrogen and phosphate levels. 1981. C.J.G. le Roux

OK-Do.44/1: Intensiewe skaapproduksiestelsel vir die kusstreek van die Oos-Kaap. 1977. F.O.C.W. Karberg

GEWASKUNDE/CROP SCIENCE

OK-Do.87/1: Evaluering van *Dactylis glomerata* in die Oos-Kaap. 1977. L.O. Nel

OK-Do.87/2: Evaluering van *Festuca arundinacea* in die Oos-Kaap. 1980. L.O. Nel

OK-Do.63/23: Seeding rate and weed control in the establishment of Rhodes grass (*Chloris gayana*). 1981. R.A. Ingpen

Eenjarige Voergewasse/Annual Fodder Crops

MANNA/MILLET

VOERPRODUKSIE/FODDER PRODUCTION

N-Ce.143/4: Collation of data from millets. 1977. F.R.T. Hyam

WORTELGEWASSE/ROOT CROPS

VOERPRODUKSIE/FODDER PRODUCTION

N-Ce.140/2: Control of *Cercospora/Cercosporella* leaf blight in Japanese radish. 1978. A.S. Hall

PEULGEWASSE/LEGUMES

VOERPRODUKSIE/FODDER PRODUCTION

N-Ce.109/4: Fodder production from legumes. 1979. (suspended)

BOS- EN STRUIKINDRINGING

N-Ec.143/5: Collation of data from legumes. 1977. F.R.T. Hyam

WEIDINGSBENUTTINGSNAVORSING: KAROOGEBIED/PASTURE UTILISATION RESEARCH: KAROO AREA

Natuurlike Weiding/Natural Pastures

VELDWEIDINGS/VELD PASTURES

VOEDING OP VELDWEIDING/NUTRITION ON VELD PASTURES

K-Gf.129/3: Vrywillige inname, verteerbaarheid en chemiese samestelling van Karooveld soos deur kleinvee geselekteer. 1974. J.P.L. Zeeman

K-Gf.124/2: Bepaling van biomassa en produksie van elf veldtipes in die Karoostreek. 1980. P. Botha

K-Gf.124/3: Bepaling van biomassa en produksie van die plantegroei van die Meentspruit-boerderyeenheid in verskillende fenologiese stadiums. 1980. P. Botha

EKOLOGIESE STUDIES/ECOLOGICAL STUDIES

K-Gf.117/1: Invloed van klimaat op plantegroei in die Karoo. 1970. E. Sykes

K-Gf.1: Veldweidingsproef op sanderige voorskootveld. 1934. P.W. Roux

K-Gf.2: Veldweidingsproef op vlakteveld. 1941. P.W. Roux

K-Gf.3: Veldweidingsproef op sandsteendolerietranteveld. 1943. P.W. Roux

SPESIESELEKSIE DEUR VEESOORTE/SPECIES SELECTION BY ANIMALS

K-Gf.127/1: Spesieseleksie en inname deur skape, beeste en bokke. 1977. P. Botha

FENOLOGIE/PHENOLOGY

K-Gf.126/1: Fotografiese opnametegnieke vir die evaluering en meet van veranderinge in Karooplantegroei. 1974. P.W. Roux

WISKUNDIGE MODELLERING/MATHEMATICAL MODELLING

K-Gf.141/2: Weiveldproduktiwiteitsmodel vir die Karoo.

BOS- EN STRUIKINDRINGING/BUSH AND SHRUB ENCROACHMENT

BEHEER VAN INDRINGERPLANTE/CONTROL OF INTRUDER PLANTS

K-Gf.143/1: Chemiese beheer van *Prosopis* spp. in die Noordwes-Karoo. 1977. M. Vorster

Meerjarige Aangeplante Weidings/Perennial Cultivated Pastures

ATRIPLEX

VOEDING VIR DIERE/NUTRITION OF ANIMALS

K-Gf.111/6: Vergelykende studie van die verteerbaarheid van drie *Atriplex* spp. 1976. G.A. Jacobs

K-Gf.111/8: Skeidundige samestelling in die *in vitro*-verteerbaarheid van *Atriplex nummularia* soos deur skape geselekteer. 1976. G.A. Jacobs

VEREDELING/IMPROVEMENT

K-Gf.98/3: Verbetering van *Atriplex nummularia* deur teling en seleksie. 1964. G.C. de Kock

LUSERN/LUCERNE

GEWASKUNDE/CROP SCIENCE

V.5454/30/1/1: An investigation of the adaptability of lucerne cultivars which are resistant to the blue-green aphid and pea aphid under irrigation at Upington. 1982. P.J. van Niekerk

VEREDELING/IMPROVEMENT

K-Gf.10: Teling en seleksie van luserncultivars. 1934. G.C. de Kock

K-Gf.69: Teling en seleksie ten opsigte van brakbestandheid van lusern. 1960. G.C. de Kock

OPTIMALE BESTUUR/OPTIMAL MANAGEMENT

K-Gf.145/1: Optimale benutting van lusern met kleinvee in die Visriviervallei. 1979. A.G. Bezuidenhout

DIVERSE VOERGEWASSE/SUNDRY FODDER CROPS

VEREDELING/IMPROVEMENT

K-Gf.98/1: Introduksie, seleksie en teelt van droogtevoergewasse vir die Karoostreek. 1964. G.C. de Kock

K-Gf.98/2: Verbetering van doringlose turksvye *Oppuntia* spp.

POTENSIAALBEPALING/POTENTIAL DETERMINATION

K-Gf.144/1: Benutting en bestuur van *Phragmites australis* (fluitjiesriet).

Eenjarige Voergewasse/Annual Fodder Crops

KLEINGRANE/SMALL GRAIN

KLEINGRANE BENUT AS VOEDING VIR DIERE/SMALL GRAIN USED AS NUTRITION FOR ANIMALS

K-Gf.79: Weidingswaarde van verskillende kleingraancultivars as groenvoer. 1960. G.C. de Kock

WEIDINGSBENUTTINGSNAVORSING: SENTRALE GRASVELDGEBIED
PASTURE UTILISATION RESEARCH: CENTRAL GRASSVELD AREA

Natuurlike Weiding/Natural Pastures

VELDWEIDINGS/VELD PASTURES

BESTUUR/MANAGEMENT

D.5461/41/1/3: The effect of frequency of defoliation on key grass species in the central grassveld areas of the Eastern Cape. 1982. J.E. Danckwerts

GEWASKUNDE/CROP SCIENCE

D.5461/30/1/3: Root growth and development of *Acacia karroo* in the central grassveld of the Eastern Cape. 1983. G. Stuart-Hill

H-Ps.60/1: Beweiding van veld gedurende bepaalde jaargetye, alleen en in kombinasie. 1963. G. Coetsee

H-Ps.228/7: Invloed van verskillende stikstof- en fostaatbemestingspeile op die plantmateriaalopbrengs van *Cymbopogon-Themeda*-veldweidings. 1970. G. Coetsee

H-Ps.228/8: Effek van hoogte van selektiewe ontblaring en bemesting op *Cymbopogon-Themeda*-veldweidings. 1970. R.H. Drewes.

H-Ps.228/9: Invloed van stikstofbronne op *Cymbopogon-Themeda*-veldweidings. 1970. G. Coetsee

H-Ps.228/11: Produktiwiteitsevaluering van veldweidings deur middel van dieregewigsveranderinge oor verskillende weitydperke. 1971. G. Coetsee

H-Ps.228/12: Invloed van benuttingspraktyke op stikstofbemeste *Cymbopogon-Themeda*-veldweidings. 1970. R.H. Drewes

H-Ps.229/1: Bestuur van veldweidings in die westelike Bankenveld wanneer met *Pachystigma pygmaeum* besmet. 1969. G. Coetsee

DIEREVOEDING/ANIMAL NUTRITION

H-Ps.173/5: Voedingswaarde van bemeste veldweidings in die westelike Bankenveld. 1971. J.W. Cilliers

ANATOMIE/ANATOMY

OK-Do.83/5: Growth and development of key grass species. 1980. J.E. Danckwerts

VELD PASTURES

OK-Do.83/6: Root growth and development of key grass species. 1980. J.E. Danckwerts

POTENSIAALBEPALING/POTENTIAL DETERMINATION

O-Gl.32: Opbou van 'n herbarium. 1952. L. Viljoen

O-Gl.72/5: Vergelykende ontblaringstudies binne 'n beheerde selektiewe beweiding met wisselende aantal kampe. 1976. L. Viljoen

OK-Do.83/1: Ontwikkeling van 'n lonende boerderystelsel te Adelaide op veldweiding. 1976. A.J. Aucamp

OK-Do.83/2: Evaluering van die produksiepotensiaal van 'n *Acacia*/grasveldweiding. 1977. A.J. Aucamp

OK-Do.83/3: Invloed van *Acacia karroo* op voerproduksie van veldweiding. 1977. A.J. Aucamp

OK-Do.83/4: Voorkeurorde en produksie van grasse op die Adelaide-proefperseel. 1979. A.J. Aucamp

OK-Do.83/10: Herbage yield and growth curves of various swards dominated by key grass species. 1980. J.E. Danckwerts

D.5461/36/1/6: The influence of seasonal defoliation of either the *Acacia karroo*, the herbaceous component or both on browse and grass production in the central grassveld. 1982. G. Stuart-Hill

EKOLOGIE/ECOLOGY

D.5461/27/1/1: The effect of *Acacia karroo* on basal cover, species composition and production of the herbaceous community in the central grassveld. 1982. G. Stuart-Hill

FISIOLOGIE/PHYSIOLOGY

OK-Do.83/7: Carbohydrate accumulation and depletion patterns in key grass species. 1980. J.E. Danckwerts

OK-Do.83/8: Crop growth rate of key grass species. 1980. J.E. Danckwerts

OK-Do.83/9: Effect of seasonality and plant age on the net assimilation rate of key grass species. 1980. J.E. Danckwerts

WATERBEHOEFTES/WATER REQUIREMENTS

D.5461/31/1/1: Water requirements and utilisation of *Acacia karroo* and key grass species during different times of the year in the central grassveld of the Eastern Cape in relation to their production. 1982. G. Stuart-Hill

LITJIESKAKTUS/JOINTED CACTUS

FISIOLOGIE/PHYSIOLOGY

OK-Do.86/2: Evaluering van belowende watermengbare onkruiddoders vir die beheer van *Opuntia aurantiaca* (litjieskaktus). 1979. A.J. Aucamp

DIVERSE VOERGEWASSE

NASSELLA

EKOLOGIE/ECOLOGY

OK-Do.68/9: Spesies vir die vervanging van nassella na chemiese uitroei. 1978. C.J.G. le Roux

FISIOLOGIE/PHYSIOLOGY

OK-Do.68/13: Evaluering van belowende watermengbare onkruiddoders op nassella-saailinge. 1980. A.J. Aucamp

OK-Do.68/10: Bestudering van chemiese en ander metodes om nassella te beheer. 1978. A.J. Aucamp

OK-Do.68/11: Invloed van eksterne omgewingsfaktore op die ontkieming van die saad van *Stipa trichotoma* (nassella). 1979. D.C. Joubert

OK-Do.68/12: Invloed van meganiese beskadiging en plantgroeistowwe op die rustoestand van die saad van *Stipa trichotoma* (nassella). 1979. D.C. Joubert

Meerjarige Aangeplante Weidings/Perennial Cultivated Pastures

CENCHRUS

BEPALING VAN DIE POTENSIAAL VAN MEERJARIGE AANGEPLANTE WEIDINGS IN DIE VRYSTAATSTREEK/DETERMINATION OF THE POTENTIAL OF PERENNIAL CULTIVATED PASTURES IN THE ORANGE FREE STATE REGION

O-Gl.143/6: Evaluasie van *Cenchrus ciliaris*-weidings vir beesvleisproduksie in die Middel-Vrystaat. 1978. P. Human

DIGITARIA

WEIDINGKUNDIGE EVALUERING/PASTURE EVALUATION

H-Ps.234/5: Invloed van weidruk en bemesting op *Digitaria smutsii* as somerweidingsgewas. 1978. C.S. Dannhauser

H-Ps.234/6: Invloed van weidruk en bemesting op *Digitaria smutsii* as staande hooi in die winter. 1978. C.S. Dannhauser

MEDICAGO

BEPALING VAN DIE POTENSIAAL VAN MEERJARIGE AANGEPLANTE WEIDINGS IN DIE VRYSTAATSTREEK/DETERMINATION OF THE POTENTIAL OF PERENNIAL CULTIVATED PASTURES IN THE ORANGE FREE STATE REGION

O-Gl.155/1: Studie van groei van vyf *Medicago*-spesies in die Middel-Vrystaat. 1980. P. Human

DIVERSE VOERGEWASSE/SUNDRY FODDER CROPS

WEIDINGKUNDIGE EVALUERING VAN DIVERSE VOERGEWASSE IN KWEKERYE/PASTURE EVALUATION OF SUNDRY FODDER CROPS IN NURSERIES

H-Ps.234/1: Kwekery-evaluering van aangeplante meerjarige grassoorte ten opsigte van aanwending as hooi- of weidingsgewasse. 1969. C.S. Dannhauser

SUNDRY FODDER CROPS

H-Ps.234/1: Kwekery-evaluering van aangeplante meerjarige peulgewasspesies ten opsigte van aanwending as hooi- of weidingsgewasse. 1940. J.A. Kruger

AANGEPLANTE WEIDINGS/CULTIVATED PASTURES

BEPALING VAN DIE POTENSIAAL VAN MEERJARIGE AANGEPLANTE WEIDINGS IN DIE VRYSTAATSTREEK/DETERMINATION OF THE POTENTIAL OF PERENNIAL CULTIVATED PASTURES IN THE ORANGE FREE STATE REGION

O-Gl.143/1: Voorlopige waardebepaling van weidingsplante in 'n kwekery te Glen. 1974. L. Viljoen

O-Gl.143/8: Bepaling van die voedingsbehoefte van *Sporobolus fimbriatus*. 1980. L. Viljoen

WEIDINGKUNDIGE ONTWIKKELING EN EVALUERING VAN AANGEPLANTE WEIDINGS PASTURE DEVELOPMENT AND EVALUATION OF CULTIVATED PASTURES

H-Ps. 28/1: Voorlopige evaluering van aangeplante meerjarige peulgewasspesies as weidingsgewasse. 1967. R.H. Drewes

H-Ps.228/16: Verskillende stelsels vir die radikale verbetering van *Cymbopogon-Themeda*-veldweidings. 1973. R.H. Drewes

H-Bl.63/5: Waarde van droëlandgras/peulgewasweidings vir melkproduksie in die Oos-Vrystaat. 1978. J.A. Kruger

H-Bl.63/6: Waarde van droëlandgras/peulgewasweidings in die Oos-Vrystaat vir skape gedurende dragtigheid en laktasie. 1978. J.A. Kruger

Eenjarige Voergewasse/Annual Fodder Crops

KLEINGRANE/SMALL GRAIN

KLEINGRANE AS WEIDINGSGEWASSE/SMALL GRAINS AS PASTURE CROPS

H-Bl.68/1: Introduksie en evaluasie van wintergroenvoergewasse in die Oos-Vrystaat. 1979. J.A. Kruger

PEULGEWASSE/LEGUMES

EENJARIGE PEULGEWASSE AS VOER- EN WEIDINGSGEWASSE/ANNUAL LEGUMES AS FODDER AND PASTURE CROPS

H-Ps.234/1: Kwekery-evaluering van aangeplante eenjarige peulgewasspesies as voer- en weidingsgewasse. 1969. C.S. Dannhauser

VOERPRODUKSIE/FODDER PRODUCTION

WEIDINGKUNDIGE ONDERSOEK NA VOERPRODUKSIE/PASTURE RESEARCH ON FODDER PRODUCTION

H-Ps.234/1: Kwekery-evaluering van aangeplante eenjarige grassoorte as somervoergewasse. 1969. C.S. Dannhauser

WEIDINGSBENUTTINGSNAVORSING: WINTERREËNGEBIED/ PASTURE UTILISATION RESEARCH: WINTER RAINFALL AREA

Natuurlike Weiding/Natural Pastures

VELDWEIDINGS/VELD PASTURES

EVALUASIE VAN VELDWEIDING/EVALUATION OF VELD PASTURES

W-Nt.1/5: Invloed van beweiding deur kleinvee en beeste op die bedekking en samestelling van die Strandveld. 1972. F.G.J. van der Westhuizen

W-Nt.1/6: Invloed van seisoenale ontblaring op die reserwes en droëmateriaalproduksie van Karoobossies en gras. 1977. F.G.J. van der Westhuizen

W-Nt.1/7: Evaluasie van *Chrysanthemoides-Medicago-* en *Atriplex*-spesies as weidingsgewasse vir Sandveld van die Weskus. 1978. F.G.J. van der Westhuizen

W-Sb.96/3: Evaluering van saadvermeerdering van natuurlike weidingsgewasse te Worcester. 1977. F.G.J. van der Westhuizen.

VOEDING VAN VELDWEIDING/NUTRITION OF VELD PASTURES

W-Eb.105/1: Voedingswaarde van bitou en roosmaryn op twee verskillende groeistadia. 1979. T.T. de Villiers

W-Eb.105/2: Voedingswaarde van plante, weidings en voere in die Winterreënstreek. 1979. T.T. de Villiers

W-Eb.105/3: Aangeplante weidings as voedingsbron vir melkbeeste in die Winterreënstreek. 1980. P.J. Swart

Meerjarige Aangeplante Weidings/Perennial Cultivated Pastures

LUSERN/LUCERNE

GEWASKUNDE/CROP SCIENCE

W.5484/35/1/1: A situation analysis in regard to the physical, socio-economic and human factors influencing the production and utilisation practices of lucerne in the irrigation areas of Oudtshoorn extension ward. 1981. B.F.A. Visser

AANGEPLANTE WEIDINGS/CULTIVATED PASTURES

POTENSIAAL/POTENTIAL

W-Tk.3/3: Drakragstudies op aangeplante weiding. 1972. J.D. Langenhoven

W-Tk.3/6: Ondersoek na Mediterreense weidingsgewasse in verskillende omgewings en onder weidingstoestande. 1973. J.M. van Heerden

W-Tk.3/11: Bepaling van die drakrag en droëlandgraspeulgewasweidings in die Rûensgebied. 1973. J.M. van Heerden

W-Tk.3/12: Evaluasie van meerjarige weidingsgewasse en -grasse onder besproeiing. 1979. J.M. van Heerden

CULTIVATED PASTURES

W-Tk.3/14: Bepaling van drakrag van 'n graspeulgewasweiding onder besproeiing. 1979. J.M. van Heerden

W-Sb.77/8: Chemiese onkruidbeheer in peulgewasweidings onder droëlandverbouing in die Winterreënstreek. 1979. J.W. Loubser

W-Tk.3/15: Voerpeulgewasse in die Swartland. 1979. J.D. Langenhoven

VOEDING/NUTRITION

W-Tk.6/2: Bepaling van die fosforvereistes van eenjarige Mediterreense peulgewasweidings. 1976. J.D. Langenhoven

W-Tk.6/3: Studie van grondvrugbaarheid met behulp van peulgewasse en kleingrane. 1978. J.D. Langenhoven

W-Tk.6/4: Studie van die stikstofbemestingsvereistes van weidingsgewasse onder besproeiing. 1979. J.D. Langenhoven

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W-Tk.3/9: Studie van mineraaltekorte en -aanvullings by skape op aangeplante weidings in die George-omgewing. 1977. N.M. Kritzinger

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W-Sb.31/1: Bestryding van lusernerdvlooi en die swart sandmyt. 1960. J. Lombard

W-Sb.17: Biologie en bestryding van *Heliothis armigera* Hmps. 1956. S.S. Walters

ONDERSTEUNENDE WEIDINGSNAVORSING/SUPPORTING PASTURE RESEARCH

Biologiese Evaluering van Voere/Biological Evaluation of Fodder

WEIDINGSGEWASSE/PASTURE PLANTS

KWALITEIT VAN WEIDINGSGEWASSE/QUALITY OF PASTURE PLANTS

N-Ce.150: Correlation between animal production and *in vitro* digestion. 1978. J.P. Marais

N-Ce.150/3: Effect of nitrogen containing fractions of kikuyu on animal production. 1978. J.P. Marais

BOTANIESE NAVORSING/BOTANICAL RESEARCH

Flora

STREEKSFLORA/REGIONAL FLORA

(A)P-Pr.3/1/1/1: Register of names and types of Poaceae. 1979. G.E. Gibbs-Russell

(A)P-Pr.3/1/1/2: Poaceae-Meliceae. 1979. G.E. Gibbs-Russell

(A)P-Pr.10/1/1/4: Xyridaceae, Eriocaulaceae, Commelinaceae, Pontederiaceae and Juncaceae. 1978. A.A. Mauve

BLOMPLANTE

(A)P-Pr.10/1/1/5: Liliaceae-Calcaraceae. 1979. A.A. Mauve

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(A)P-Pr.3/1/1/9: Lamiaceae. 1973. L.E.W. Codd

(A)P-Pr.3/1/1/10: Malvaceae. 1964. O.A. Leistner

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(A)P-Pr.3/1/1/15: Register and bibliography of freshwater algae (Chlorophyceae). 1979. R.P. Glen

(A)P-Pr.3/1/1/16: Botanical collectors. 1969. L.E.W. Codd

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(A)P-Pr.49: Poaceae sub-families Oryzoideae. Centostecoideae and Bambusoideae. G.E. Gibbs-Russel

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(A)P-Pr.51: The tribe Desmodieae (Fabaceae-Papilionoideae). 1981. B.D. Schrire

(A)P-Pr.35/1/2/1: Illustrated flora of the Pretoria region. 1973. O.A. Leistner

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(A)P-Ph.2/2/1/1: Tribal plant uses in South Africa. 1977. C.A. Liengme

(A)P-Ph.2/2/1/2: Role of indigenous plants, particularly mopani, in Tsonga tribal economy. 1979. C.A. Liengme

(A)P-Pr.42/2/2/1: Iron and Stone Age ethnobotany of Border Cave, Lebombo Mountain. 1976. J.M. Anderson

BLOMPLANTE/FLOWERING PLANTS

TAKSONOMIESE EN BIOSISTEMIESE STUDIES/TAXONOMIC AND BIOSYSTEMIC STUDIES

(A)P-Pr.3/3/1/1: Taxonomic revision of *Ficinia* (section Bracteoseae), *Carpha* and *Elaeocharis*. 1976. T.H. Arnold

(A)P-Pr.46/3/1/3: Taxonomic revision of Polygonaceae. 1979. G. Germishuizen

(A)P-Pr.27/3/2/1: Biosystemic study of the *Eragrostis curvula* complex. 1972. B. de Winter, W. Gaum

(A)P-Pr.6/3/3/1: Flowering plants of Africa. 1918. D.J. B. Killick

FLOWERING PLANTS

ANATOMIESE STUDIES/ANATOMICAL STUDIES

(A)P-Pr.26/4/1/1: Comparative anatomy of the grass sub-family Arundinoideae. 1972. R.P. Ellis

(A)P-Pr.26/4/1/2: Comparative anatomy of the grass sub-family Oryzoideae. R.P. Ellis

(A)P-Pr.26/4/1/3: Comparative anatomy of the grass sub-family Festucoideae. R.P. Ellis

(A)P-Pr.26/4/1/4: Comparative anatomy of the grass sub-family Panicoideae. R.P. Ellis

(A)P-Pr.26/4/1/5: Comparative anatomy of the grass sub-family Eragrostoideae. R.P. Ellis

(A)P-Pr.26/4/1/6: Comparative anatomy of the grass sub-family Aristidoideae. R.P. Ellis

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PLANTGEOGRAFIESE EN DISTRIBUSIESTUDIES/PLANT-GEOGRAPHICAL AND DISTRIBUTION STUDIES

(A)P-Pr.45/1/5/1/2: Interim distribution atlas of the woody plants of the Transvaal. 1979. J.M. Anderson

(A)P-Pr.45/2/5/1/3: Final distribution atlas of the woody plants of the Transvaal. 1979. J.M. Anderson

FOSSIELPLANTE/FOSSIL PLANTS

TAKSONOMIE/TAXONOMY

(A)P-Pr.44/1/6/1/1: Palaeoflora of the Upper Triassic Molteno Formation in South Africa. J.M. Anderson, H.M. Anderson

AFRIKAANSE PLANTEGROEI/AFRICAN VEGETATION

EKOLOGIE/ECOLOGY

(A)P-Pr.30/7/1/1: Plant-ecological bibliography for Southern Africa up to 1975. 1972. D. Edwards, D.B.J. Killick

(A)P-Pr.30/7/1/2: Plant-ecological bibliography for Southern Africa for 1976-1980. 1976. D. Edwards, J.C. Scheepers

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(A)P-Pr.9/7/3/1: Monitoring of vegetation change in South Africa on protected areas. 1960. J.C. Scheepers, R.M. Westfall, C. Boucher, B.M. Campbell, H.C. Taylor, P.J. Weisser

(A)P-Pr.22/7/3/2: Stability of basal cover in natural grassland. 1966. J.W. Morris

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EKOLOGIE/ECOLOGY

(A)P-Pr.37/2/8/1/1: Seasonal growth of woody plants in the Nylsvley *Burkea* Savanna Ecosystem Project. 1975. M.C. Rutherford

(A)P-Pr.47/8/2/1: Plant ecology of the farm Groothoek, Thabazimbi district. 1980. R.M. Westfall

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EKOLOGIE/ECOLOGY

(A)P-Pr.8/1/9/1/1: Vegetation transects through the western Cape forelands. 1977. C. Boucher

(A)P-Pr.8/2/9/1/2: Semi-detailed regional ecological study of the western Cape foreland fynbos. 1978. C. Boucher

(A)P-Sb.5/1/9/2/1: Plant-ecological study of the Cape Point Nature Reserve. 1965. H.C. Taylor

(A)P-Sb.5/3/9/2/2: Structural-functional classification of mountain fynbos. 1978. B.M. Campbell

WATERPLANTE/AQUATIC PLANTS

EKOLOGIE/ECOLOGY

(A)P-Db.3/1/10/1/1: Aquatic macrophyte communities of Natal. 1974. C.F. Musil

BOSSE/FORESTS

EKOLOGIE/ECOLOGY

(A)P-Pr.38/2/19/1/1: Vegetation survey of the Zululand coastal dunes between Richards Bay and Mlalazi Lagoon. 1980. P.J. Weisser

(A)P-Sb.10/10/1/2: Vegetation study of the estuaries from the Kei River to the Orange River. 1981. R.J. Parsons

VOEDSELPLANTE/FOOD PLANTS

INHEEMSE VOEDSELPLANTE VIR POTENSIËLE EKSPLOITASIE/INDIGENOUS FOOD PLANTS FOR POTENTIAL EXPLOITATION

(A)P-Ph.2/11/1/1: Collection and preservation of germ plasm of primitive crop plants. 1979. T.H. Arnold

TAKSONOMIE/TAXONOMY

(A)P-Ph.2/12/1/1: Origins and evolution of indigenous sorghums. 1979. T.H. Arnold

(A)P-Ph.2/12/1/2: Origins and evolution of indigenous *Pennisetum* food plants. 1979. K.J. Duggan, T.H. Arnold

DEK- EN VERSPERRINGSPLANTE/COVER AND BARRIER PLANTS

DEK- EN VERSPERRINGSPLANTE VIR POTENSIËLE EKSPLOITASIE/COVER AND BARRIER PLANTS FOR POTENTIAL EXPLOITATION

(A)P-Ph.2/13/1/1: Survey of potential drought and cold resistant cover and barrier plants. 1979. L. Henderson, D. Edwards, D.S. Hardy, A.A. Balsinhas

(A)P-Ph.2/13/1/2: Survey of potential cover and barrier plants for moist and warm areas. 1979. L. Henderson, D. Edwards, D.S. Hardy, A.A. Balsinhas

ONKRUID EN GIFPLANTE/WEEDS AND POISONOUS PLANTS

TAKSONOMIE/TAXONOMY

(A)P-Pr.40/14/1/1: Biosystemic study of *Lantana camara* in southern Africa. 1975. C.H. Stirton

(A)P-Ph.2/14/1/2: Biosystematics of introduced *Rubus* in South Africa. 1979. C.H. Stirton

EKOLOGIE/ECOLOGY

(A)P-Db.3/2/15/1/1: Field and laboratory growth of *Eichhornia crassipes* in relation to nitrogen and phosphorus loading. 1974. C.F. Musil

PLANTGEOGRAFIE EN DISTRIBUSIE/PLANT GEOGRAPHY AND DISTRIBUTION

(A)P-Ph.2/16/1/1: Woody plant invaders of the Transvaal. 1979. M.J. Wells, K.J. Duggan, L. Henderson

EVALUASIE/EVALUATION

(A)P-Ph.2/17/1/1: Compilation and maintenance of national weed list. 1979. M.J. Wells, C.H. Stirton, A.A. Balsinhas, E. van Hoepen

NASSELLA

EKOLOGIE/ECOLOGY

(A)P-Ph.2/18/1/1: Review of knowledge of nassella tussock grass. 1972. M.J. Wells

(A)P-Ph.2/18/2/1: Reproduction, dispersal and establishment of nassella tussock in the Winter Rainfall Region. 1979. G. Harding

(A)P-Ph.2/18/2/2: Longevity of nassella tussock grass seed. 1978. M.J. Wells

BEMARKING/MARKETING

BEMARKINGSNAVORSING/MARKETING RESEARCH

Skattings/Estimates

AKKERBOU/AGRONOMY

SOMERGRAAN, BEMARKINGSEKONOMIE/SUMMER GRAIN, MARKETING ECONOMY

(A)LBN-Pr.1/1: Oppervlakte- en vooruitskatting van oeste ten opsigte van mielies, graansorghum, grondbone, sonneblomsaad, sojabone en droëbone.

(A)LBN-Pr.1/2: Bepaling van die werklike oesgrootte en aanwending van die oes.

WINTERGRAAN, BEMARKINGSEKONOMIE/WINTER GRAIN, MARKETING ECONOMY

(A)LBN-Pr.2/1: Oppervlakte- en vooruitskatting van oeste ten opsigte van koring, hawer, gars, rog en lupine.

(A)LBN-Pr.2/2: Bepaling van werklike oesgrootte.

Statistiek/Statistics

FISIES/PHYSIOLOGICAL

VEEVOERSTATISTIEK, BEMARKINGSEKONOMIE/ANIMAL FEED STATISTICS, MARKETING ECONOMY

(A)LBN-Pr.6/1: Insameling, verwerking en ontleding van gegewens ten opsigte van produksie, verbruik, voorrade, invoer en uitvoer van gebalanseerde veevoere op 'n kwartaalbasis.

BRANDSTOFVERKOPE, BEMARKINGSEKONOMIE/FUEL SALES, MARKETING ECONOMY

(A)LBN-Pr.7/1: Versameling van hoeveelhede petrol, kragparaffien, dieselolie, olie en ghries wat jaarliks aan boere en landboukoöperasies verkoop word.

VERKOPE OP MARKTE, BEMARKINGSEKONOMIE/SALES ON MARKETS, MARKETING ECONOMY

(A)LBN-Pr.8/1: Berekening van die hoeveelheid produkte wat op die 14 Nasionale Varsproduktemarkte verkoop word, maandeliks en jaarliks.

(A)LBN-Pr.8/2: Berekening van die waarde van die produkte wat maandeliks en jaarliks op die 14 Nasionale Varsproduktemarkte verkoop word en die gemiddelde waarde per ton.

PUBLISERING VAN LANDBOUSTATISTIEK/PUBLISHING OF AGRICULTURAL STATISTICS

(A)LBN-Pr.9/1: Versameling, samestelling, verwerking en publisering van alle landboustatistiek in die Kortbegrip van Landboustatistiek.

MONETêR/MONETARY

BRUTO WAARDE VAN LANDBOUPRODUKSIE, BEMARKINGSEKONOMIE/GROSS VALUE OF AGRICULTURAL PRODUCTION, MARKETING ECONOMY

LBN-Pr.10/1: Berekening van die totale van landbouproduksie teen plaaspryse.

VOEDSELMANDJIE, BEMARKINGSEKONOMIE/FOOD BASKET, MARKETING ECONOMY

(A)LBN-Pr.11/1: Bepaling van die marge tussen die prys wat die produsent ontvang en dié wat die verbruiker betaal vir 'n sekere aantal produkte wat in die voedselmandjie ingesluit word.

KLEINHANDELSPRYSE VAN GROENTE EN VRUGTE, BEMARKINGSEKONOMIE/RETAIL PRICES OF VEGETABLES AND FRUIT, MARKETING ECONOMY

(A)LBN-Pr.12/1: Opnames van kleinhandelspryse van groente en vrugte in die vernaamste stedelike gebiede om die prysverloop daarvan vas te stel.

INDEKSE/INDEXES

PRYSINDEKSE, BEMARKINGSEKONOMIE/PRICE INDEXES, MARKETING ECONOMY

(A)LBN-Pr.13/1: Samestelling van 'n prysindeks wat die verloop van die pryse van boerdery-benodigdhede soos kapitaalgoedere, materiaal vir vaste verbeterings, intermediêre goedere en dienste asook alle boederybenodigdhede weergee.

(A)LBN-Pr.13/2: Samestelling van 'n prysindeks wat die verloop van die produsentepryse van landbouprodukte, groepe produkte asook vir alle landbouprodukte gekombineerd weergee.

(A)LBN-Pr.13/3: Samestelling van 'n indeks van die volume en eenheidswaarde van landbouprodukte uitgevoer volgens die Laspeyres- en die Paasche-metode.

(A)LBN-Pr.13/4: Samestelling van 'n volume-indeks wat die jaarlikse produksie van landbouprodukte en produksieneigings oor jare aantoon.

(A)LBN-Pr.13/5: Samestelling van 'n grondprysindeks gebaseer op oordragte van plattelandse onroerende eiendom in die somerreën-, Winterreën-, beeswei-, skaapwei- en Natalstreek.

VOEDSELBALANSSTAAT/FOOD BALANCE SHEET

BINNELANDSE VERBRUIK, BEMARKINGSEKONOMIE/INLAND CONSUMPTION, MARKETING ECONOMY

(A)LBN-Pr.14/1: Berekening van die per kop verbruik en inname van proteïen en vette van voedselitems in die Republiek.

Landbourekeninge/Agricultural Accounts

PRODUKSIEREKENING/PRODUCTION ACCOUNT

PRODUKSIEPROSES IN DIE LANDBOU/PRODUCTION PROCESS IN AGRICULTURE

(A)LBN-Pr.15/1: Bydrae van die landbou tot die bruto binnelandse produk en die netto boerdery-inkomste word op 'n kwartaalbasis bereken.

STATISTIEK

(A)LBN-Pr.15/2: Berekening van die bydrae van landbou tot die bruto binnelandse produk teen kontantpryse.

KAPITAALREKENING/CAPITAL ACCOUNT

KWARTAALLIKSE EN JAARLIKSE INVESTERING TEN OPSIGTE VAN VASTE VERBETERINGS, MASJINERIE EN VOERTUIE ASOOK DIE VERANDERING IN DIE VEE-INVENTARIS/ QUATERLY AND ANNUAL INVESTING IN CONNECTION WITH FIXED IMPROVEMENTS, MACHINERY AND VEHICLES AS WELL AS THE CHANGE IN THE STOCK INVENTARY.

STREEKSREKENINGE/REGIONAL ACCOUNTS

STREEKSBEREKENINGE IN DIE LANDBOU, BEMARKINGSEKONOMIE/REGIONAL CALCULATION IN AGRICULTURE, MARKETING ECONOMY

(A)LBN-Pr.17/1: Berekening van die landbousektor se bydrae tot die landsekonomie volgens landdrosdistrikte en landboustreke.

VERBRUIKSBESTEDING/CONSUMER SPENDING

VERBRUIKSBESTEDING AAN VOEDSEL, BEMARKINGSEKONOMIE/CONSUMER SPENDING ON FOOD, MARKETING ECONOMY

(A)LBN-Pr.18/1: Bedrae wat aan voedsel, drank en tabak bestee word, word kwartaalliks bereken.

Produksiekoste-opname/Production Costs Survey

AKKERBOU/AGRONOMY

PRODUKSIEKOSTE-AANPASSINGS/PRODUCTION COST ADAPTATIONS

(A)LBN-Pr.19/1: Aanpassing van die kostesyfers van die Afdeling Landbouproduksie-ekonomie se koste-opnames van mielies, koring, grondbone, sonneblomsaad, sojabone en tabak om die jaarlikse verandering in produksiekoste teenoor die vorige jaar te meet.

TUINBOU/HORTICULTURE

PRODUKSIEKOSTE-AANPASSINGS/PRODUCTION COST ADAPTATION

(A)LBN-Pr.20/1: Aanpassing van die kostesyfers van die Afdeling Landbouproduksie-ekonomie se koste-opnames van sagtevrugte, droëvrugte en inmaakvrugte.

Bevordering van Buitelandse Bemarking/Promotion of Foreign Marketing

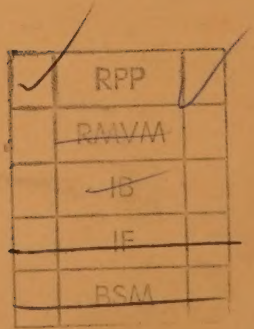
STATISTIEK/STATISTICS

OORSESE PRYSE VAN LANDBOUPRODUKTE/OVERSEAS PRICES OF AGRICULTURAL PRODUCTS

(A)LBN-Pr.21/1: Insameling en verwerking op 'n deurlopende grondslag van pryse van landbouprodukte in die buiteland.

LUGUITVOER VAN BEDERFBARE LANDBOUPRODUKTE/AIR EXPORTING OF PERISHABLE AGRICULTURAL PRODUCTS

(A)LBN-Pr.22/1: Insameling en verwerking op 'n deurlopende grondslag van gegewens ten opsigte van die hoeveelhede, waardes en lande van bestemming van bederfbare Suid-Afrikaanse landbouprodukte per lugvrag uitgevoer.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